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Frank H. Cilley.

PERSONAL NARRATIVE

OF

TRAVELS

TO THE

EQUINOCTIAL REGIONS OF AMERICA,

DURING THE YEARS 1799—1804.

BY ALEXANDER VON HUMBOLDT AND AIMÉ BONPLAND.

WRITTEN IN FRENCH BY

ALEXANDER VON HUMBOLDT:

TRANSLATED AND EDITED BY THOMASINA ROSS.

IN THREE VOLUMES.

VOL. I.

LONDON:

HENRY G. BOHN, YORK STREET, COVENT GARDEN.

1852.

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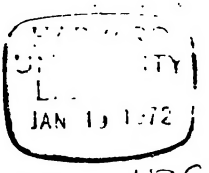

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EDITOR'S PREFACE.

THE increasing interest attached to all that part of the American Continent situated within and near the tropics, has suggested the publication of the present edition of Humboldt's celebrated work, as a portion of the SCIENTIFIC LIBRARY.

Prior to the travels of Humboldt and Bonpland, the countries described in the following narrative were but imperfectly known to Europeans. For our partial acquaintance with them we were chiefly indebted to the early navigators, and to some of the followers of the Spanish Conquistadores. The intrepid men whose courage and enterprise prompted them to explore unknown seas for the discovery of a New World, have left behind them narratives of their adventures, and descriptions of the strange lands and people they visited, which must ever be perused with curiosity and interest; and some of the followers of Pizarro and Cortez, as well as many learned Spaniards who proceeded to South America soon after the conquest, were the authors of historical and other works of high value. But these writings of a past age, however curious and interesting, are deficient in that spirit of scientific investigation which enhances the importance and utility of accounts of travels in distant regions. In more recent times, the researches of La Condamine tended in a most important degree to promote geographical knowledge; and he, as well as other eminent botanists who visited the coasts of South

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America, and even ascended the Andes, contributed by their discoveries and collections to augment the vegetable riches of the Old World. But, in their time, geology as a science had little or no existence. Of the structure of the giant mountains of our globe scarcely anything was understood; whilst nothing was known beneath the earth in the New World, except what related to her mines of gold and silver.

It remained for Humboldt to supply all that was wanting, by the publication of his Personal Narrative. In this, more than in any other of his works, he shows his power of contemplating nature in all her grandeur and variety.

The researches and discoveries of Humboldt's able coadjutor and companion, M. Bonpland, afford not only a complete picture of the botany of the equinoctial regions of America, but of that of other places visited by the travellers on their voyage thither. The description of the Island of Teneriffe and the geography of its vegetation, show how much was discovered by Humboldt and Bonpland which had escaped the observation of discerning travellers who had pursued the same route before them. Indeed, the whole account of the Canary Islands presents a picture which cannot be contemplated without the deepest interest, even by persons comparatively indifferent to the study of nature.

It is, perhaps, scarcely necessary to remind the reader that since the time when this work was first published in Paris, the separation of the Spanish Colonies from the mother-country, together with subsequent political events, have wrought great changes in the governments of the South American States, as well as in the social condition of their inhabitants. One consequence of these changes has been to render obsolete some facts and observations relating to subjects, political, commercial, and statistical, interspersed through this work. However useful such matter might have been on its original publication, it is wholly irrelevant

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to the existing state of things, and consequently it has been deemed advisable to omit it. By this curtailment, together with that of some meteorological tables and discussions of very limited interest, the work has been divested of its somewhat lengthy and discursive character, and condensed within dimensions better adapted to the taste and requirements of the present time.

An English translation of this work by Helen Maria Williams, was published many years ago, and is now out of print. Though faultless as respects correctness of interpretation, it abounds in foreign turns of expression, and is somewhat deficient in that fluency of style without which a translated work is unsatisfactory to the English reader. In the edition now presented to the public it is hoped that these objections are in some degree removed.

A careful English version is given of all the Spanish and Portuguese terms, phrases, and quotations which occur in this work. Though the author has only in some few instances given a French translation of these passages, yet it is presumed that the interpretation of the whole in English will not be deemed superfluous; this new edition of the "Personal Narrative" having been undertaken with the view of presenting the work in the form best suited for the instruction and entertainment of the general reader.

T. R.

LONDON, *December* 1851.

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For the sake of accuracy, the French Measures, as given by the Author, and the indications of the Centigrade Thermometer, are retained in the translation. The following tables may, therefore, be found useful.

Table of Linear Measure.

1 toise = 6 ft. 4·73 in. 1 foot = 12·78 in. 1 metre = 3 ft. 3·37 in.

Centigrade Thermometer reduced to Fahrenheit's Scale.

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
100	212	65	149	30	86	5	23
99	210·2	64	147·2	29	84·2	6	21·2
98	208·4	63	145·4	28	82·4	7	19·4
97	206·6	62	143·6	27	80·6	8	17·6
96	204·8	61	141·8	26	78·8	9	15·8
95	203	60	140	25	77	10	14
94	201·2	59	138·2	24	75·2	11	12·2
93	199·4	58	136·4	23	73·4	12	10·4
92	197·6	57	134·6	22	71·6	13	8·6
91	195. 8	56	132·8	21	69·8	14	6·8
90	194	55	131	20	68	15	5
89	192·2	54	129·2	19	66·2	16	3·2
88	190·4	53	127·4	18	64·4	17	1·4
87	188·6	52	125. 6	17	62·6	18	—0·4
86	186·8	51	123·8	16	60·8	19	2. 2
85	185	50	122	15	59	20	4
84	183·2	49	120·2	14	57·2	21	5·8
83	181·4	48	118·4	13	55·4	22	7·6
82	179·6	47	116·6	12	53·6	23	9·4
81	177·8	46	114·8	11	51·8	24	11·2
80	176	45	113	10	50	25	13
79	174·2	44	111·2	9	48·2	26	14·8
78	172·4	43	109·4	8	46·4	27	16·6
77	170·6	42	107·6	7	44·6	28	18·4
76	168·8	41	105·8	6	42·8	29	20·2
75	167	40	104	5	41	30	22
74	165·2	39	102·2	4	39·2	31	23·8
73	163·4	38	100·4	3	37·4	32	25·6
72	161·6	37	98·6	2	35·6	33	27·4
71	159·8	36	96·8	1	33·8	34	29·2
70	158	35	95	0	32	35	31
69	156·2	34	93·2	—1	30·2	36	32·8
68	154·4	33	91·4	2	28·4	37	34·6
67	152·6	32	89·6	3	26·6	38	36·4
66	150·8	31	87·8	4	24·8	39	38·2

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INTRODUCTION,

BY

THE AUTHOR.

MANY years have elapsed since I quitted Europe, to explore the interior of the New Continent. Devoted from my earliest youth to the study of nature, feeling with enthusiasm the wild beauties of a country guarded by mountains and shaded by ancient forests, I experienced in my travels, enjoyments which have amply compensated for the privations inseparable from a laborious and often agitated life. These enjoyments, which I endeavoured to impart to my readers in my 'Remarks upon the Steppes,' and in the 'Essay on the Physiognomy of Plants,' were not the only fruits I reaped from an undertaking formed with the design of contributing to the progress of natural philosophy. I had long prepared myself for the observations which were the principal object of my journey to the torrid zone. I was provided with instruments of easy and convenient use, constructed by the ablest makers, and I enjoyed the special protection of a government which, far from presenting obstacles to my investigations, constantly honoured me with every mark of regard and confidence. I was aided by a courageous and enlightened friend, and it was singularly propitious to the success of our participated labour, that the zeal and equanimity of that friend never failed, amidst the fatigues and dangers to which we were sometimes exposed.

Under these favourable circumstances, traversing regions which for ages have remained almost unknown to most of the nations of Europe, I might add even to Spain, M. Bonpland and myself collected a considerable number of materials, the publication of which may throw some light on the history of nations, and advance the study of nature.

I had in view a two-fold purpose in the travels of which I now publish the historical narrative. I wished to make known the countries I had visited; and to collect such facts as are fitted to elucidate a science of which we as yet possess scarcely the outline, and which has been vaguely denominated Natural His-

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tory of the World, Theory of the Earth, or Physical Geography. The last of these two objects seemed to me the most important. I was passionately devoted to botany and certain parts of zoology, and I flattered myself that our investigations might add some new species to those already known, both in the animal and vegetable kingdoms; but preferring the connection of facts which have been long observed, to the knowledge of insulated facts, although new, the discovery of an unknown genus seemed to me far less interesting than an observation on the geographical relations of the vegetable world, on the migrations of the social plants, and the limit of the height which their different tribes attain on the flanks of the Cordilleras.

The natural sciences are connected by the same ties which link together all the phenomena of nature. The classification of the species, which must be considered as the fundamental part of botany, and the study of which is rendered attractive and easy by the introduction of natural methods, is to the geography of plants what descriptive mineralogy is to the indication of the rocks constituting the exterior crust of the globe. To comprehend the laws observed in the position of these rocks, to determine the age of their successive formations, and their identity in the most distant regions, the geologist should be previously acquainted with the simple fossils which compose the mass of mountains, and of which the names and character are the object of oryctognostical knowledge. It is the same with that part of the natural history of the globe which treats of the relations plants have to each other, to the soil whence they spring, or to the air which they inhale and modify. The progress of the geography of plants depends in a great measure on that of descriptive botany; and it would be injurious to the advancement of science, to attempt rising to general ideas, whilst neglecting the knowledge of particular facts.

I have been guided by these considerations in the course of my inquiries; they were always present to my mind during the period of my preparatory studies. When I began to read the numerous narratives of travels, which compose so interesting a part of modern literature, I regretted that travellers, the most enlightened in the insulated branches of natural history, were seldom possessed of sufficient variety of knowledge to avail themselves of every advantage arising from their position. It appeared to me, that the importance of the results hitherto obtained did not keep pace with the immense progress which, at the end of the eighteenth century, had been made in several departments of science, particularly geology, the history of the modifications of the atmosphere, and the physiology of animals and plants. I saw with regret, (and all scientific men have shared this feeling) that whilst the number of accurate instruments was daily in-

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creasing, we were still ignorant of the height of many mountains and elevated plains; of the periodical oscillations of the aërial ocean; of the limit of perpetual snow within the polar circle and on the borders of the torrid zone; of the variable intensity of the magnetic forces, and of many other phenomena equally important.

Maritime expeditions and circumnavigatory voyages have conferred just celebrity on the names of the naturalists and astronomers who have been appointed by various governments to share the dangers of those undertakings; but though these eminent men have given us precise notions of the external configuration of countries, of the natural history of the ocean, and of the productions of islands and coasts, it must be admitted that maritime expeditions are less fitted to advance the progress of geology and other parts of physical science, than travels into the interior of a continent. The advancement of the natural sciences has been subordinate to that of geography and nautical astronomy. During a voyage of several years, the land but seldom presents itself to the observation of the mariner; and when, after lengthened expectation, it is descried, he often finds it stripped of its most beautiful productions. Sometimes, beyond a barren coast, he perceives a ridge of mountains covered with verdure, but its distance forbids examination, and the view serves only to excite regret.

Journeys by land are attended with considerable difficulties in the conveyance of instruments and collections, but these difficulties are compensated by advantages which it is unnecessary to enumerate. It is not by sailing along a coast that we can discover the direction of chains of mountains, and their geological constitution, the climate of each zone, and its influence on the forms and habits of organized beings. In proportion to the extent of continents, the greater on the surface of the soil are the riches of animal and vegetable productions; the more distant the central chain of mountains from the sea-shore, the greater is the variety in the bosom of the earth, of those stony strata, the regular succession of which unfolds the history of our planet. As every being considered apart is impressed with a particular type, so, in like manner, we find the same distinctive impression in the arrangement of brute matter organized in rocks, and also in the distribution and mutual relations of plants and animals. The great problem of the physical description of the globe, is the determination of the form of these types, the laws of their relations with each other, and the eternal ties which link the phenomena of life, and those of inanimate nature.

Having stated the general object I had in view in my expeditions, I will now hasten to give a slight sketch of the whole of the collections and observations which we have accumulated,

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and the union of which is the aim and end of every scientific journey. The maritime war, during our abode in America, having rendered communication with Europe very uncertain, we found ourselves compelled, in order to diminish the chance of losses, to form three different collections. Of these, the first was embarked for Spain and France, the second for the United States and England, and the third, which was the most considerable, remained almost constantly under our own eyes. Towards the close of our expedition, this last collection formed forty-two boxes, containing an herbal of six thousand equinoctial plants, seeds, shells, insects, and (what had hitherto never been brought to Europe) geological specimens, from the Chimborazo, New Grenada, and the banks of the river Amazon.

After our journey to the Orinoco, we left a part of these collections at the island of Cuba, intending to take them on our return from Peru to Mexico. The rest followed us during the space of five years, on the chain of the Andes, across New Spain, from the shores of the Pacific to the coasts of the Caribbean Sea. The conveyance of these objects, and the minute care they required, occasioned embarrassments scarcely conceiveable even by those who have traversed the most uncultivated parts of Europe. Our progress was often retarded by the necessity of dragging after us, during expeditions of five or six months, twelve, fifteen, and sometimes more than twenty loaded mules, exchanging these animals every eight or ten days, and superintending the Indians who were employed in driving the numerous caravan. Often, in order to add to our collections of new mineral substances, we found ourselves obliged to throw away others, which we had collected a considerable time before. These sacrifices were not less vexatious than the losses we accidentally sustained. Sad experience taught us but too late, that from the sultry humidity of the climate, and the frequent falls of the beasts of burden, we could preserve neither the skins of animals hastily prepared, nor the fishes and reptiles placed in phials filled with alcohol. I enter into these details, because, though little interesting in themselves, they serve to show that we had no means of bringing back, in their natural state, many objects of zoology and comparative anatomy, of which we have published descriptions and drawings. Notwithstanding some obstacles, and the expense occasioned by the carriage of these articles, I had reason to applaud the resolution I had taken before my departure, of sending to Europe the duplicates only of the productions we collected. I cannot too often repeat, that when the seas are infested with privateers, a traveller can be sure only of the objects in his own possession. A very few of the duplicates, which we shipped for Europe during our abode in America, were saved; the greater part fell into the hands of persons who feel no interest for

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science. When a ship is condemned in a foreign port, boxes containing only dried plants or stones, instead of being sent to the scientific men to whom they are addressed, are put aside and forgotten. Some of our geological collections taken in the Pacific were, however, more fortunate. We were indebted for their preservation to the generous activity of Sir Joseph Banks, President of the Royal Society of London, who, amidst the political agitations of Europe, unceasingly laboured to strengthen the bonds of union between scientific men of all nations.

In our investigations we have considered each phenomenon under different aspects, and classed our remarks according to the relations they bear to each other. To afford an idea of the method we have followed, I will here add a succinct enumeration of the materials with which we were furnished for describing the volcanos of Antisana and Pichincha, as well as that of Jorullo: the latter, during the night of the 20th of September, 1759, rose from the earth one thousand five hundred and seventy-eight French feet above the surrounding plains of Mexico. The position of these singular mountains in longitude and latitude was ascertained by astronomical observations. We took the heights of the different parts by the aid of the barometer, and determined the dip of the needle and the intensity of the magnetic forces. Our collections contain the plants which are spread over the flanks of these volcanos, and specimens of different rocks which, superposed one upon another, constitute their external coat. We are enabled to indicate, by measures sufficiently exact, the height above the level of the ocean, at which we found each group of plants, and each volcanic rock. Our journals furnish us with a series of observations on the humidity, the temperature, the electricity, and the degree of transparency of the air on the brinks of the craters of Pichincha and Jorullo; they also contain topographical plans and geological profiles of these mountains, founded in part on the measure of vertical bases, and on angles of altitude. Each observation has been calculated according to the tables and the methods which are considered most exact in the present state of our knowledge; and in order to judge of the degree of confidence which the results may claim, we have preserved the whole detail of our partial operations.

It would have been possible to blend these different materials in a work devoted wholly to the description of the volcanos of Peru and New Spain. Had I given the physical description of a single province, I could have treated separately everything relating to its geography, mineralogy, and botany; but how could I interrupt the narrative of a journey, a disquisition on the manners of a people, or the great phenomena of nature, by an enumeration of the productions of the country, the description of new species of animals and plants, or the detail of astrono-

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mical observations. Had I adopted a mode of composition which would have included in one and the same chapter all that has been observed on one particular point of the globe, I should have prepared a work of cumbrous length, and devoid of that clearness which arises in a great measure from the methodical distribution of matter. Notwithstanding the efforts I have made to avoid, in this narrative, the errors I had to dread, I feel conscious that I have not always succeeded in separating the observations of detail from those general results which interest every enlightened mind. These results comprise in one view the climate and its influence on organized beings, the aspect of the country, varied according to the nature of the soil and its vegetable covering, the direction of the mountains and rivers which separate races of men as well as tribes of plants; and finally, the modifications observable in the condition of people living in different latitudes, and in circumstances more or less favourable to the development of their faculties. I do not fear having too much enlarged on objects so worthy of attention: one of the noblest characteristics which distinguish modern civilization from that of remoter times is, that it has enlarged the mass of our conceptions, rendered us more capable of perceiving the connection between the physical and intellectual world, and thrown a more general interest over objects which heretofore occupied only a few scientific men, because those objects were contemplated separately, and from a narrower point of view.

As it is probable that these volumes will obtain the attention of a greater number of readers than the detail of my observations merely scientific, or my researches on the population, the commerce, and the mines of New Spain, I may be permitted here to enumerate all the works which I have hitherto published conjointly with M. Bonpland. When several works are interwoven in some sort with each other, it may perhaps be interesting to the reader to know the sources whence he may obtain more circumstantial information.

I. *Astronomical observations, trigonometrical operations, and barometrical measurements made during the course of a journey to the equinoctial regions of the New Continent, from* 1799 *to* 1804. This work, to which are added historical researches on the position of several points important to navigators, contains, first, the original observations which I made from the twelfth degree of southern to the forty-first degree of northern latitude; the transits of the sun and stars over the meridian; distances of the moon from the sun and the stars; occultations of the satellites; eclipses of the sun and moon; transits of Mercury over the disc of the sun; azimuths; circum-meridian altitudes of the moon, to determine the longitude by the differences of declination; researches on the relative intensity of the light of the

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austral stars; geodesical measures, &c. Secondly, a treatise on the astronomical refractions in the torrid zone, considered as the effect of the decrement of caloric in the strata of the air; thirdly, the barometric measurement of the Cordillera of the Andes, of Mexico, of the province of Venezuela, of the kingdom of Quito, and of New Grenada; followed by geological observations, and containing the indication of four hundred and fifty-three heights, calculated according to the method of M. Laplace, and the new co-efficient of M. Ramond; fourthly, a table of near seven hundred geographical positions on the New Continent; two hundred and thirty-five of which have been determined by my own observations, according to the three co-ordinates of longitude, latitude, and height.

II. *Equinoctial plants collected in Mexico, in the island of Cuba, in the provinces of Caracas, Cumana, and Barcelona, on the Andes of New Grenada, Quito, and Peru, and on the banks of the Rio Negro, the Orinoco, and the River Amazon.* M. Bonpland has in this work given figures of more than forty new genera of plants of the torrid zone, classed according to their natural families. The methodical descriptions of the species are both in French and in Latin, and are accompanied by observations on the medicinal properties of the plants, their use in the arts, and the climate of the countries in which they are found.

III. *Monography of the Melastoma, Rhexia, and other genera of this order of plants*, comprising upwards of a hundred and fifty species of melastomaceæ, which we collected during the course of our expeditions, and which form one of the most beautiful ornaments of tropical vegetation. M. Bonpland has added the plants of the same family, which, among many other rich stores of natural history, M. Richard collected in his interesting expedition to the Antilles and French Guiana, and the descriptions of which he has communicated to us.

IV. *Essay on the geography of plants, accompanied by a physical table of the equinoctial regions, founded on measures taken from the tenth degree of northern to the tenth degree of southern latitude.* I have endeavoured to collect in one point of view the whole of the physical phenomena of that part of the New Continent comprised within the limits of the torrid zone from the level of the Pacific to the highest summit of the Andes; namely, the vegetation, the animals, the geological relations, the cultivation of the soil, the temperature of the air, the limit of perpetual snow, the chemical constitution of the atmosphere, its electrical intensity, its barometrical pressure, the decrement of gravitation, the intensity of the azure colour of the sky, the diminution of light during its passage through the successive strata of the air, the horizontal refractions, and the heat of boiling water at different heights. Fourteen scales, disposed side by side with a

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profile of the Andes, indicate the modifications to which these phenomena are subject from the influence of the elevation of the soil above the level of the sea. Each group of plants is placed at the height which nature has assigned to it, and we may follow the prodigious variety of their forms from the region of the palms and arborescent ferns to those of the johannesia (chuquiraga, *Juss.*), the gramineous plants, and lichens. These regions form the natural divisions of the vegetable empire; and as perpetual snow is found in each climate at a determinate height, so, in like manner, the febrifuge species of the quinquina (cinchona) have their fixed limits, which I have marked in the botanical chart belonging to this essay.

V. *Observations on Zoology and Comparative Anatomy.* I have comprised in this work the history of the condor; experiments on the electrical action of the gymnotus; a treatise on the larynx of the crocodiles, the quadrumani, and birds of the tropics; the description of several new species of reptiles, fishes, birds, monkeys, and other mammalia but little known. M. Cuvier has enriched this work with a very comprehensive treatise on the axolotl of the lake of Mexico, and on the genera of the Protei. That naturalist has also recognized two new species of mastodons and an elephant among the fossil bones of quadrupeds which we brought from North and South America. For the description of the insects collected by M. Bonpland we are indebted to M. Latreille, whose labours have so much contributed to the progress of entomology in our times. The second volume of this work contains figures of the Mexican, Peruvian, and Aturian skulls, which we have deposited in the Museum of Natural History at Paris, and respecting which Blumenbach has published observations in the 'Decas quinta Craniorum diversarum gentium.'

VI. *Political essay on the kingdom of New Spain, with a physical and geographical Atlas, founded on astronomical observations and trigonometrical and barometrical measurements.* This work, based on numerous official memoirs, presents, in six divisions, considerations on the extent and natural appearance of Mexico, on the population, on the manners of the inhabitants, their ancient civilization, and the political division of their territory. It embraces also the agriculture, the mineral riches, the manufactures, the commerce, the finances, and the military defence of that vast country. In treating these different subjects I have endeavoured to consider them under a general point of view; I have drawn a parallel not only between New Spain, the other Spanish colonies, and the United States of North America, but also between New Spain and the possessions of the English in Asia; I have compared the agriculture of the countries situated in the torrid zone with that of the temperate climates; and I have examined the quantity of colonial produce

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necessary to Europe in the present state of civilization. In tracing the geological description of the richest mining districts in Mexico, I have, in short, given a statement of the mineral produce, the population, the imports and exports of the whole of Spanish America. I have examined several questions which, for want of precise data, had not hitherto been treated with the attention they demand, such as the influx and reflux of metals, their progressive accumulation in Europe and Asia, and the quantity of gold and silver which, since the discovery of America down to our own times, the Old World has received from the New. The geographical introduction at the beginning of this work contains the analysis of the materials which have been employed in the construction of the Mexican Atlas.

VII. *Views of the Cordilleras, and monuments of the indigenous nations of the New Continent.** This work is intended to represent a few of the grand scenes which nature presents in the lofty chain of the Andes, and at the same time to throw some light on the ancient civilization of the Americans, through the study of their monuments of architecture, their hieroglyphics, their religious rites, and their astrological reveries. I have given in this work a description of the *teocalli*, or Mexican pyramids, and have compared their structure with that of the temple of Belus. I have described the arabesques which cover the ruins of Mitla, the idols in basalt ornamented with the *calantica* of the heads of Isis; and also a considerable number of symbolical paintings, representing the serpent-woman (the Mexican Eve), the deluge of Coxcox, and the first migrations of the natives of the Aztec race. I have endeavoured to prove the striking analogies existing between the calendar of the Toltecs and the catasterisms of their zodiac, and the division of time of the people of Tartary and Thibet, as well as the Mexican traditions on the four regenerations of the globe, the *pralayas* of the Hindoos, and the four ages of Hesiod. In this work I have also included (in addition to the hieroglyphical paintings I brought to Europe), fragments of all the Aztec manuscripts, collected in Rome, Veletri, Vienna, and Dresden, and one of which reminds us, by its lineary symbols, of the *kouas* of the Chinese. Together with the rude monuments of the aborigines of America, this volume contains picturesque views of the mountainous countries which those people inhabited; for example, the cataract of Tequendama, Chimborazo, the volcano of Jorullo, and Cayambe, the pyramidal summit of which, covered with eternal ice, is situated directly under the equinoctial line. In every zone the configuration of the ground, the physiognomy

* Atlas Pittoresque, ou Vues des Cordillères, 1 vol. folio, with 69 plates, part of which are coloured, accompanied by explanatory treatises. This work may be considered as the Atlas to the historical narrative of the travels.

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of the plants, and the aspect of lovely or wild scenery, have great influence on the progress of the arts, and on the style which distinguishes their productions. This influence is so much the more perceptible in proportion as man is farther removed from civilization.

I could have added to this work researches on the character of languages, which are the most durable monuments of nations. I have collected a number of materials on the languages of America, of which MM. Frederic Schlegel and Vater have made use; the former in his Considerations on the Hindoos, the latter in his Continuation of the Mithridates of Adelung, in the Ethnographical Magazine, and in his Inquiries into the Population of the New Continent. These materials are now in the hands of my brother, William von Humboldt, who, during his travels in Spain, and a long abode at Rome, formed the richest collection of American vocabularies in existence. His extensive knowledge of the ancient and modern languages has enabled him to trace some curious analogies in relation to this subject, so important to the philosophical study of the history of man. A part of his labours will find a place in this narrative.

Of the different works which I have here enumerated, the second and third were composed by M. Bonpland, from the observations which he made in a botanical journal. This journal contains more than four thousand methodical descriptions of equinoctial plants, a ninth part only of which have been made by me. They appear in a separate publication, under the title of *Nova Genera et Species Plantarum*. In this work will be found, not only the new species we collected, which, after a careful examination by one of the first botanists of the age, Prof. Willdenow, are computed to amount to fourteen or fifteen hundred, but also the interesting observations made by M. Bonpland on plants hitherto imperfectly described. The plates of this work are all engraved according to the method followed by M. Labillardière, in the *Specimen Plantarum Novæ Hollandiæ*, a work remarkable for profound research and clearness of arrangement.

After having distributed into separate works all that belongs to astronomy, botany, zoology, the political description of New Spain, and the history of the ancient civilization of certain nations of the New Continent, there still remained many general results and local descriptions, which I might have collected into separate treatises. I had, during my journey, prepared papers on the races of men in South America; on the Missions of the Orinoco; on the obstacles to the progress of society in the torrid zone arising from the climate and the strength of vegetation; on the character of the landscape in the Cordilleras of the Andes compared with that of the Alps in Switzerland; on the analogies

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between the rocks of the two hemispheres; on the physical constitution of the air in the equinoctial regions, &c. I had left Europe with the firm intention of not writing what is usually called the historical narrative of a journey, but to publish the fruit of my inquiries in works merely descriptive; and I had arranged the facts, not in the order in which they successively presented themselves, but according to the relation they bore to each other. Amidst the overwhelming majesty of Nature, and the stupendous objects she presents at every step, the traveller is little disposed to record in his journal matters which relate only to himself, and the ordinary details of life.

I composed a very brief itinerary during the course of my excursions on the rivers of South America, and in my long journies by land. I regularly described (and almost always on the spot) the visits I made to the summits of volcanos, or mountains remarkable for their height; but the entries in my journal were interrupted whenever I resided in a town, or when other occupations prevented me from continuing a work which I considered as having only a secondary interest. Whenever I wrote in my journal, I had no other motive than the preservation of some of those fugitive ideas which present themselves to a naturalist, whose life is almost wholly passed in the open air. I wished to make a temporary collection of such facts as I had not then leisure to class, and note down the first impressions, whether agreeable or painful, which I received from nature or from man. Far from thinking at the time that those pages thus hurriedly written would form the basis of an extensive work to be offered to the public, it appeared to me, that my journal, though it might furnish certain data useful to science, would present very few of those incidents, the recital of which constitutes the principal charm of an itinerary.

The difficulties I have experienced since my return, in the composition of a considerable number of treatises, for the purpose of making known certain classes of phenomena, insensibly overcame my repugnance to write the narrative of my journey. In undertaking this task, I have been guided by the advice of many estimable persons, who honour me with their friendship. I also perceived that such a preference is given to this sort of composition, that scientific men, after having presented in an isolated form the account of their researches on the productions, the manners, and the political state of the countries through which they have passed, imagine that they have not fulfilled their engagements with the public, till they have written their itinerary.

An historical narrative embraces two very distinct objects; the greater or the less important events connected with the purpose of the traveller, and the observations he has made during his journey. The unity of composition also, which distinguishes

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good works from those on an ill-constructed plan, can be strictly observed only when the traveller describes what has passed under his own eye; and when his principal attention has been fixed less on scientific observations than on the manners of different people and the great phenomena of nature. Now, the most faithful picture of manners is that which best displays the relations of men towards each other. The character of savage or civilized life is portrayed either in the obstacles a traveller meets with, or in the sensations he feels. It is the traveller himself whom we continually desire to see in contact with the objects which surround him; and his narration interests us the more, when a local tint is diffused over the description of a country and its inhabitants. Such is the source of the interest excited by the history of those early navigators, who, impelled by intrepidity rather than by science, struggled against the elements in their search for the discovery of a new world. Such is the irresistible charm attached to the fate of that enterprising traveller,* who, full of enthusiasm and energy, penetrated alone into the centre of Africa, to discover amidst barbarous nations the traces of ancient civilization.

In proportion as travels have been undertaken by persons whose views have been directed to researches into descriptive natural history, geography, or political economy, itineraries have partly lost that unity of composition, and that simplicity which characterized those of former ages. It is now become scarcely possible to connect so many different materials with the detail of other events; and that part of a traveller's narrative which we may call dramatic gives way to dissertations merely descriptive. The numerous class of readers who prefer agreeable amusement to solid instruction, have not gained by the exchange; and I am afraid that the temptation will not be great to follow the course of travellers who are incumbered with scientific instruments and collections.

To give greater variety to my work, I have often interrupted the historical narrative by descriptions. I first represent phenomena in the order in which they appeared; and I afterwards consider them in the whole of their individual relations. This mode has been successfully followed in the journey of M. de Saussure, whose most valuable work has contributed more than any other to the advancement of science. Often, amidst dry discussions on meteorology, it contains many charming descriptions; such as those of the modes of life of the inhabitants of the mountains, the dangers of hunting the chamois, and the sensations felt on the summit of the higher Alps.

There are details of ordinary life which it may be useful to

* Mungo Park.

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note in an itinerary, because they serve for the guidance of those who afterwards journey through the same countries. I have preserved a few, but have suppressed the greater part of those personal incidents which present no particular interest, and which can be rendered amusing only by the perfection of style.

With respect to the country which has been the object of my investigations, I am fully sensible of the great advantages enjoyed by persons who travel in Greece, Egypt, the banks of the Euphrates, and the islands of the Pacific, in comparison with those who traverse the continent of America. In the Old World, nations and the distinctions of their civilization form the principal points in the picture; in the New World, man and his productions almost disappear amidst the stupendous display of wild and gigantic nature. The human race in the New World presents only a few remnants of indigenous hordes, slightly advanced in civilization; or it exhibits merely the uniformity of manners and institutions transplanted by European colonists to foreign shores. Information which relates to the history of our species, to the various forms of government, to monuments of art, to places full of great remembrances, affect us far more than descriptions of those vast solitudes which seem destined only for the development of vegetable life, and to be the domain of wild animals. The savages of America, who have been the objects of so many systematic reveries, and on whom M. Volney has lately published some accurate and intelligent observations, inspire less interest since celebrated navigators have made known to us the inhabitants of the South Sea islands, in whose character we find a striking mixture of perversity and meekness. The state of half-civilization existing among those islanders gives a peculiar charm to the description of their manners. A king, followed by a numerous suite, presents the fruits of his orchard; or a funeral is performed amidst the shade of the lofty forest. Such pictures, no doubt, have more attraction than those which portray the solemn gravity of the inhabitant of the banks of the Missouri or the Maranon.

America offers an ample field for the labours of the naturalist. On no other part of the globe is he called upon more powerfully by nature to raise himself to general ideas on the cause of phenomena and their mutual connection. To say nothing of that luxuriance of vegetation, that eternal spring of organic life, those climates varying by stages as we climb the flanks of the Cordilleras, and those majestic rivers which a celebrated writer* has described with such graceful accuracy, the resources which the New World affords for the study of geology and natural

* M. Chateaubriand.

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philosophy in general have been long since acknowledged. Happy the traveller who may cherish the hope that he has availed himself of the advantages of his position, and that he has added some new facts to the mass of those previously acquired!

Since I left America, one of those great revolutions, which at certain periods agitate the human race, has broken out in the Spanish colonies, and seems to prepare new destinies for a population of fourteen millions of inhabitants, spreading from the southern to the northern hemisphere, from the shores of the Rio de la Plata and Chile to the remotest part of Mexico. Deep resentments, excited by colonial legislation, and fostered by mistrustful policy, have stained with blood regions which had enjoyed, for the space of nearly three centuries, what I will not call happiness but uninterrupted peace. At Quito several of the most virtuous and enlightened citizens have perished, victims of devotion to their country. While I am giving the description of regions, the remembrance of which is so dear to me, I continually light on places which recall to my mind the loss of a friend.

When we reflect on the great political agitations of the New World, we observe that the Spanish Americans are by no means in so favourable a position as the inhabitants of the United States; the latter having been prepared for independence by the long enjoyment of constitutional liberty. Internal dissensions are chiefly to be dreaded in regions where civilization is but slightly rooted, and where, from the influence of climate, forests may soon regain their empire over cleared lands if their culture be abandoned. It may also be feared that, during a long series of years, no foreign traveller will be enabled to traverse all the countries which I have visited. This circumstance may perhaps add to the interest of a work which pourtrays the state of the greater part of the Spanish colonies at the beginning of the 19th century. I even venture to indulge the hope that this work will be thought worthy of attention when passions shall be hushed into peace, and when, under the influence of a new social order, those countries shall have made rapid progress in public welfare. If then some pages of my book are snatched from oblivion, the inhabitant of the banks of the Orinoco and the Atabapo will behold with delight populous cities enriched by commerce, and fertile fields cultivated by the hands of free men, on those very spots where, at the time of my travels, I found only impenetrable forests and inundated lands.

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PERSONAL NARRATIVE

OF A

JOURNEY

TO THE

EQUINOCTIAL REGIONS

OF

THE NEW CONTINENT.

Chapter I.

Preparations.—Instruments.—Departure from Spain.—Landing at the Canary Islands.

From my earliest youth I felt an ardent desire to travel into distant regions, seldom visited by Europeans. This desire is characteristic of a period of our existence when life appears an unlimited horizon, and when we find an irresistible attraction in the impetuous agitations of the mind, and the image of positive danger. Though educated in a country which has no direct communication with either the East or the West Indies, living amidst mountains remote from coasts, and celebrated for their numerous mines, I felt an increasing passion for the sea and distant expeditions. Objects with which we are acquainted only by the animated narratives of travellers have a peculiar charm; imagination wanders with delight over that which is vague and undefined; and the pleasures we are deprived of seem to possess a fascinating power, compared with which all we daily feel

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in the narrow circle of sedentary life appears insipid. The taste for herborisation, the study of geology, rapid excursions to Holland, England, and France, with the celebrated Mr. George Forster, who had the happiness to accompany captain Cook in his second expedition round the globe, contributed to give a determined direction to the plan of travels which I had formed at eighteen years of age. No longer deluded by the agitation of a wandering life, I was anxious to contemplate nature in all her variety of wild and stupendous scenery; and the hope of collecting some facts useful to the advancement of science, incessantly impelled my wishes towards the luxuriant regions of the torrid zone. As personal circumstances then prevented me from executing the projects by which I was so powerfully influenced, I had leisure to prepare myself during six years for the observations I proposed to make on the New Continent, as well as to visit different parts of Europe, and to explore the lofty chain of the Alps, the structure of which I might afterwards compare with that of the Andes of Quito and of Peru.

I had traversed a part of Italy in 1795, but had not been able to visit the volcanic regions of Naples and Sicily; and I regretted leaving Europe without having seen Vesuvius, Stromboli, and Etna. I felt, that in order to form a proper judgment of many geological phenomena, especially of the nature of the rocks of trap-formation, it was necessary to examine the phenomena presented by burning volcanoes. I determined therefore to return to Italy in the month of November, 1797. I made a long stay at Vienna, where the fine collections of exotic plants, and the friendship of Messrs. de Jacquin, and Joseph van der Schott, were highly useful to my preparatory studies. I travelled with M. Leopold von Buch, through several cantons of Salzburg and Styria, countries alike interesting to the landscape-painter and the geologist; but just when I was about to cross the Tyrolese Alps, the war then raging in Italy obliged me to abandon the project of going to Naples.

A short time before, a gentleman passionately fond of the fine arts, and who had visited the coasts of Greece and Illyria to inspect their monuments, made me a proposal to accompany him in an expedition to Upper Egypt. This

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expedition was to occupy only eight months. Provided with astronomical instruments and able draughtsmen, we were to ascend the Nile as far as Assouan, after minutely examining the positions of the Saïd, between Tentyris and the cataracts. Though my views had not hitherto been fixed on any region but the tropics, I could not resist the temptation of visiting countries so celebrated in the annals of human civilization. I therefore accepted this proposition, but with the express condition, that on our return to Alexandria I should be at liberty to continue my journey through Syria and Palestine. The studies which I entered upon with a view to this new project, I afterwards found useful, when I examined the relations between the barbarous monuments of Mexico, and those belonging to the nations of the old world. I thought myself on the point of embarking for Egypt, when political events forced me to abandon a plan which promised me so much satisfaction.

An expedition of discovery in the South Sea, under the direction of captain Baudin, was then preparing in France. The plan was great, bold, and worthy of being executed by a more enlightened commander. The purpose of this expedition was to visit the Spanish possessions of South America, from the mouth of the river Plata to the kingdom of Quito and the isthmus of Panama. After visiting the archipelago of the Pacific, and exploring the coasts of New Holland, from Van Diemen's Land to that of Nuyts, both vessels were to stop at Madagascar, and return by the Cape of Good Hope. I was in Paris when the preparations for this voyage were begun. I had but little confidence in the personal character of captain Baudin, who had given cause of discontent to the court of Vienna, when he was commissioned to conduct to Brazil one of my friends, the young botanist, Van der Schott; but as I could not hope, with my own resources, to make a voyage of such extent, and view so fine a portion of the globe, I determined to take the chances of this expedition. I obtained permission to embark, with the instruments I had collected, in one of the vessels destined for the South Sea, and I reserved to myself the liberty of leaving captain Baudin whenever I thought proper. M. Michaux, who had already visited Persia and a part of North America, and M. Bonpland, with whom I

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then formed the friendship that still unites us, were appointed to accompany this expedition as naturalists.

I had flattered myself during several months with the idea of sharing the labours directed to so great and honourable an object when the war which broke out in Germany and Italy, determined the French government to withdraw the funds granted for their voyage of discovery, and adjourn it to an indefinite period. Deeply mortified at finding the plans I had formed during many years of my life overthrown in a single day, I sought at any risk the speediest means of quitting Europe, and engaging in some enterprise which might console me for my disappointment.

I became acquainted with a Swedish consul, named Skioldebrand, who having been appointed by his court to carry presents to the dey of Algiers, was passing through Paris, to embark at Marseilles. This estimable man had resided a long time on the coast of Africa; and being highly respected by the government of Algiers, he could easily procure me permission to visit that part of the chain of the Atlas which had not been the object of the important researches of M. Desfontaines. He despatched every year a vessel for Tunis, where the pilgrims embarked for Mecca, and he promised to convey me by the same medium to Egypt. I eagerly seized so favourable an opportunity, and thought myself on the point of executing a plan which I had formed previously to my arrival in France. No mineralogist had yet examined that lofty chain of mountains which, in the empire of Morocco, rises to the limits of the perpetual snow. I flattered myself, that, after executing some operations in the alpine regions of Barbary, I should receive in Egypt from those illustrious men who had for some months formed the Institute of Cairo, the same kind attentions with which I had been honoured during my abode in Paris. I hastily completed my collection of instruments, and purchased works relating to the countries I was going to visit. I parted from a brother who, by his advice and example, had hitherto exercised a great influence on the direction of my thoughts. He approved the motives which determined me to quit Europe; a secret voice assured us that we should meet again; and that hope, which did not prove delusive, assuaged the pain of a long separation. I left Paris with the intention

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of embarking for Algiers and Egypt; but by one of those vicissitudes which sway the affairs of this life, I returned to my brother from the river Amazon and Peru, without having touched the continent of Africa.

The Swedish frigate which was to convey M. Skioldebrand to Algiers, was expected at Marseilles toward the end of October. M. Bonpland and myself repaired thither with great celerity, for during our journey we were tormented with the fear of being too late, and missing our passage.

M. Skioldebrand was no less impatient than ourselves to reach his place of destination. Several times a day we climbed the mountain of Notre Dame de la Garde, which commands an extensive view of the Mediterranean. Every sail we descried in the horizon excited in us the most eager emotion; but after two months of anxiety and vain expectation, we learned by the public papers, that the Swedish frigate which was to convey us, had suffered greatly in a storm on the coast of Portugal, and had been forced to enter the port of Cadiz, to refit. This news was confirmed by private letters, assuring us that the Jaramas, which was the name of the frigate, would not reach Marseilles before the spring.

We felt no inclination to prolong our stay in Provence till that period. The country, and especially the climate, were delightful, but the aspect of the sea reminded us of the failure of our projects. In an excursion we made to Hyères and Toulon, we found in the latter port the frigate la Boudeuse, which had been commanded by M. de Bougainville, in his voyage round the world. She was then fitting out for Corsica. M. de Bougainville had honoured me with particular kindness during my stay in Paris, when I was preparing to accompany the expedition of captain Baudin. I cannot describe the impression made upon my mind by the sight of the vessel which had carried Commerson to the islands of the South Sea. In some conditions of the mind, a painful emotion blends itself with all our feelings.

We still persisted in the intention of visiting the African coast, and were nearly becoming the victims of our perseverance. A small vessel of Ragusa, on the point of setting sail for Tunis, was at that time in the port of Marseilles; we thought the opportunity favourable for reaching Egypt and

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Syria, and we agreed with the captain for our passage. The vessel was to sail the following day; but a circumstance trivial in itself happily prevented our departure. The live-stock intended to serve us for food during our passage, was kept in the great cabin. We desired that some changes should be made, which were indispensable for the safety of our instruments; and during this interval we learnt at Marseilles, that the government of Tunis persecuted the French residing in Barbary, and that every person coming from a French port was thrown into a dungeon. Having escaped this imminent danger, we were compelled to suspend the execution of our projects. We resolved to pass the winter in Spain, in hopes of embarking the next spring, either at Carthagena, or at Cadiz, if the political situation of the East permitted.

We crossed Catalonia and the kingdom of Valencia, on our way to Madrid. We visited the ruins of Tarragona and those of ancient Saguntum; and from Barcelona we made an excursion to Montserrat, the lofty peaks of which are inhabited by hermits, and where the contrast between luxuriant vegetation and masses of naked and arid rocks, forms a landscape of a peculiar character. I employed myself in ascertaining by astronomical observations the position of several points important for the geography of Spain, and determined by means of the barometer the height of the central plain. I likewise made several observations on the inclination of the needle, and on the intensity of the magnetic forces.

On my arrival at Madrid I had reason to congratulate myself on the resolution I had formed of visiting the Peninsula. Baron de Forell, minister from the court of Saxony, treated me with a degree of kindness, of which I soon felt the value. He was well versed in mineralogy, and was full of zeal for every undertaking that promoted the progress of knowledge. He observed to me, that under the administration of an enlightened minister, Don Mariano Luis de Urquijo, I might hope to obtain permission to visit, at my own expense, the interior of Spanish America. After the disappointments I had suffered, I did not hesitate a moment to adopt this idea.

I was presented at the court of Aranjuez in March 1799,

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and the king received me graciously. I explained to him the motives which led me to undertake a voyage to the new world and the Philippine Islands, and I presented a memoir on the subject to the secretary of state. Señor de Urquijo supported my demand, and overcame every obstacle. I obtained two passports, one from the first secretary of state, the other from the council of the Indies. Never had so extensive a permission been granted to any traveller, and never had any foreigner been honoured with more confidence on the part of the Spanish government.

Many considerations might have induced us to prolong our abode in Spain. The abbé Cavanilles, no less remarkable for the variety of his attainments than his acute intelligence; M. Nee, who, together with M. Hænke, had, as botanist, made part of the expedition of Malaspina, and who had formed one of the greatest herbals ever seen in Europe; Don Casimir Ortega, the abbé Pourret, and the learned authors of the Flora of Peru, Messrs. Rüiz and Pavon, all opened to us without reserve their rich collections. We examined part of the plants of Mexico, discovered by Messrs. Sesse, Mocino, and Cervantes, whose drawings had been sent to the Museum of Natural History of Madrid. This great establishment, the direction of which was confided to Señor Clavijo, author of an elegant translation of the works of Buffon, offered us, it is true, no geological representation of the Cordilleras, but M. Proust, so well known by the great accuracy of his chemical labours, and a distinguished mineralogist, M. Hergen, gave us curious details on several mineral substances of America. It would have been useful to us to have employed a longer time in studying the productions of the countries which were to be the objects of our research, but our impatience to take advantage of the permission given us by the court was too great to suffer us to delay our departure. For a year past, I had experienced so many disappointments, that I could scarcely persuade myself that my most ardent wishes would be at length fulfilled.

We left Madrid about the middle of May, crossed a part of Old Castile, the kingdoms of Leon and Galicia, and reached Corunna, whence we were to embark for Cuba. The winter having been protracted and severe, we enjoyed

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during the journey that mild temperature of the spring, which in so southern a latitude usually occurs during March and April. The snow still covered the lofty granitic tops of the Guadarama; but in the deep vallies of Galicia, which resemble the most picturesque spots of Switzerland and the Tyrol, cistuses loaded with flowers; and arborescent heaths clothed every rock. We quitted without regret the elevated plain of the two Castiles, which is everywhere devoid of vegetation, and where the severity of the winter's cold is followed by the overwhelming heat of summer. From the few observations I personally made, the interior of Spain forms a vast plain, elevated three hundred toises (five hundred and eighty-four metres) above the level of the ocean, is covered with secondary formations, grit-stone, gypsum, sal-gem, and the calcareous stone of Jura. The climate of the Castiles is much colder than that of Toulon and Genoa; its mean temperature scarcely rises to 15° of the centigrade thermometer.

We are astonished to find that, in the latitude of Calabria, Thessaly, and Asia Minor, orange-trees do not flourish in the open air. The central elevated plain is encircled by a low and narrow zone, where the chamærops, the date-tree, the sugar-cane, the banana, and a number of plants common to Spain and the north of Africa, vegetate on several spots, without suffering from the rigours of winter. From the 36th to 40th degrees of latitude, the medium temperature of this zone is from 17 to 20 degrees; and by a concurrence of circumstances, which it would be too long to explain, this favoured region has become the principal seat of industry and intellectual improvement.

When, in the kingdom of Valencia, we ascend from the shore of the Mediterranean towards the lofty plains of La Mancha and the Castiles, we seem to discern, far inland, from the lengthened declivities, the ancient coast of the Peninsula. This curious phenomenon recalls the traditions of the Samothracians, and other historical testimonies, according to which it is supposed that the irruption of the waters through the Dardanelles, augmenting the basin of the Mediterranean, rent and overflowed the southern part of Europe. If we admit that these traditions owe their origin, not to mere geological reveries, but to the remembrance of some ancient catastrophe,

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we may conceive the central elevated plain of Spain resisting the efforts of these great inundations, till the draining of the waters, by the straits formed between the pillars of Hercules, brought the Mediterranean progressively to its present level, lower Egypt emerging above its surface on the one side, and the fertile plains of Tarragona, Valencia, and Murcia, on the other. Everything that relates to the formation of that sea,* which has had so powerful an influence on the first civilization of mankind, is highly interesting. We might suppose, that Spain, forming a promontory amidst the waves, was indebted for its preservation to the height of its land; but in order to give weight to these theoretic ideas, we must clear up the doubts that have arisen respecting the rupture of so many transverse dikes;—we must discuss the probability of the Mediterranean having been formerly divided into several separate basins, of which Sicily and the island of Candia appear to mark the ancient limits. We will not here risk the solution of these problems, but will satisfy ourselves in fixing attention on the striking contrast in the configuration of the land in the eastern and western extremities of Europe. Between the Baltic and the Black Sea, the ground is at present scarcely fifty toises above the level of the ocean, while the plain of La Mancha, if placed between the sources of the Niemen and the Borysthenes, would figure as a group of mountains of considerable height. If the causes, which may have changed the surface of our planet, be an interesting speculation, investigations of the phenomena, such as they offer themselves to the measures and observations of the naturalist, lead to far greater certainty.

From Astorga to Corunna, especially from Lugo, the

* Some of the ancient geographers believed that the Mediterranean, swelled by the waters of the Euxine, the Palus Mæotis, the Caspian Sea, and the Sea of Aral, had broken the pillars of Hercules; others admitted that the irruption was made by the waters of the ocean. In the first of these hypotheses, the height of the land between the Black Sea and the Baltic, and between the ports of Cette and Bordeaux, determine the limit which the accumulation of the waters may have reached before the junction of the Black Sea, the Mediterranean, and the Atlantic, as well to the north of the Dardanelles, as to the east of this strip of land which formerly joined Europe to Mauritania, and of which, in the time of Strabo, certain vestiges remained in the Islands of Juno and the Moon.

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mountains rise gradually. The secondary formations gently disappear, and are succeeded by the transition rocks, which indicate the proximity of primitive strata. We found considerable mountains composed of that ancient gray stone which the mineralogists of the school of Freyberg name *grauwakke*, and *grauwakkenschiefer*. I do not know whether this formation, which is not frequent in the south of Europe, has hitherto been discovered in other parts of Spain. Angular fragments of Lydian stone, scattered along the vallies, seemed to indicate that the transition schist is the basis of the strata of graywacke. Near Corunna even granitic ridges stretch as far as Cape Ortegal. These granites, which seem formerly to have been contiguous to those of Britanny and Cornwall, are perhaps the wrecks of a chain of mountains destroyed and sunk in the waves. Large and beautiful crystals of feldspar characterise this rock. Common tin ore is sometimes discovered there, but working the mines is a laborious and unprofitable operation for the inhabitants of Galicia.

The first secretary of state had recommended us very particularly to brigadier Don Raphael Clavijo, who was employed in forming new dock-yards at Corunna. He advised us to embark on board the sloop Pizarro,* which was to sail in company with the Alcudia, the packet-boat of the month of May, which, on account of the blockade, had been detained three weeks in the port. Señor Clavijo ordered the necessary arrangements to be made on board the sloop for placing our instruments, and the captain of the Pizarro received orders to stop at Teneriffe, as long as we should judge necessary to enable us to visit the port of Orotava, and ascend the peak.

We had yet ten days to wait before we embarked. During this interval, we employed ourselves in preparing the plants we had collected in the beautiful vallies of Galicia, which no naturalist had yet visited: we examined the fuci and the molluscæ which the north-west winds had cast with great profusion at the foot of the steep rock, on which the light-house of the Tower of Hercules is built. This edifice, called also the Iron Tower, was repaired in 1788. It is ninety-two feet high, its walls are four feet and a half thick, and its construction clearly proves that it was built by the Romans. An

* According to the Spanish nomenclature, the Pizarro was a light frigate (fragata lijera).

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inscription discovered near its foundation, a copy of which M. Laborde obligingly gave me, informs us, that this pharos was constructed by Caius Sevius Lupus, architect of the city of Aqua Flavia (Chaves), and that it was dedicated to Mars. Why is the Iron Tower called in the country by the name of Hercules? Was it built by the Romans on the ruins of a Greek or Phœnician edifice? Strabo, indeed, affirms that Galicia, the country of the Callæci, had been peopled by Greek colonies. According to an extract from the geography of Spain, by Asclepiades the Myrlæan, an ancient tradition stated that the companions of Hercules had settled in these countries.

The ports of Ferrol and Corunna both communicate with one bay, so that a vessel driven by bad weather towards the coast may anchor in either, according to the wind. This advantage is invaluable where the sea is almost always tempestuous, as between capes Ortegal and Finisterre, which are the promontories Trileucum and Artabrum of ancient geography. A narrow passage, flanked by perpendicular rocks of granite, leads to the extensive basin of Ferrol. No port in Europe has so extraordinary an anchorage, from its very inland position. The narrow and tortuous passage by which vessels enter this port, has been opened, either by the irruption of the waves, or by the reiterated shocks of very violent earthquakes. In the New World, on the coasts of New Andalusia, the Laguna del Obispo (Bishop's lake) is formed exactly like the port of Ferrol. The most curious geological phenomena are often repeated at immense distances on the surface of continents; and naturalists who have examined different parts of the globe, are struck with the extreme resemblance observed in the rents on coasts, in the sinuosities of the vallies, in the aspect of the mountains, and in their distribution by groups. The accidental concurrence of the same causes must have everywhere produced the same effects; and amidst the variety of nature, an analogy of structure and form is observed in the arrangement of inanimate matter, as well as in the internal organization of plants and of animals.

Crossing from Corunna to Ferrol, over a shallow, near the White Signal, in the bay, which according to D'Anville is the Portus Magnus of the ancients, we made several experi-

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ments by means of a valved thermometrical sounding lead, on the temperature of the ocean, and on the decrement of caloric in the successive strata of water. The thermometer on the bank, and near the surface, was from 12·5° to 13·3° centigrades, while in deep water it constantly marked 15° or 15·3°, the air being at 12·8°. The celebrated Franklin and Mr. Jonathan Williams * were the first to invite the attention of naturalists to the phenomena of the temperature of the Atlantic over shoals, and in that zone of tepid and flowing waters which runs from the gulf of Mexico to the banks of Newfoundland and the northern coasts of Europe. The observation, that the proximity of a sand-bank is indicated by a rapid descent of the temperature of the sea at its surface, is not only interesting to the naturalist, but may become also very important for the safety of navigators. The use of the thermometer ought certainly not to lead us to neglect the use of the lead; but experiments sufficiently prove, that variations of temperature, sensible to the most imperfect instruments, indicate danger long before the vessel reaches the shoals. In such cases, the frigidity of the water may induce the pilot to heave the lead in places where he thought himself in the most perfect safety. The waters which cover the shoals owe in a great measure the diminution of their temperature to their mixture with the lower strata of water, which rise towards the surface on the edge of the banks.

The moment of leaving Europe for the first time is attended with a solemn feeling. We in vain summon to our minds the frequency of the communication between the two worlds; we in vain reflect on the great facility with which, from the improved state of navigation, we traverse the Atlantic, which compared to the Pacific is but a larger arm of the sea; the sentiment we feel when we first undertake so distant a voyage is not the less accompanied by a deep emotion, unlike any other impression we have hitherto felt. Separated from the objects of our dearest affections, entering in some sort on a new state of existence, we are forced to fall back on our own thoughts, and we feel within ourselves a dreariness we have never known before. Among the letters which, at the time of our embarking, I wrote to friends in

* Author of a work entitled "Thermometrical Navigation," published at Philadelphia.

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France and Germany, one had a considerable influence on the direction of our travels, and on our succeeding operations. When I left Paris with the intention of visiting the coast of Africa, the expedition for discoveries in the Pacific seemed to be adjourned for several years. I had agreed with captain Baudin, that if, contrary to his expectation, his voyage took place at an earlier period, and intelligence of it should reach me in time, I would endeavour to return from Algiers to a port in France or Spain, to join the expedition. I renewed this promise on leaving Europe, and wrote to M. Baudin, that if the government persisted in sending him by Cape Horn, I would endeavour to meet him either at Monte Video, Chile, or Lima, or wherever he should touch in the Spanish colonies. In consequence of this engagement, I changed the plan of my journey, on reading in the American papers, in 1801, that the French expedition had sailed from Havre, to circumnavigate the globe from east to west. I hired a small vessel from Batabano, in the island of Cuba, to Portobello, and thence crossed the isthmus to the coast of the Pacific; this mistake of a journalist led M. Bonpland and myself to travel eight hundred leagues through a country we had no intention to visit. It was only at Quito, that a letter from M. Delambre, perpetual secretary of the first class of the Institute, informed us, that captain Baudin went by the Cape of Good Hope, without touching on the eastern or western coasts of America.

We spent two days at Corunna, after our instruments were embarked. A thick fog, which covered the horizon, at length indicated the change of weather we so anxiously desired. On the 4th of June, in the evening, the wind turned to north-east, a point which, on the coast of Galicia, is considered very constant during the summer. The Pizarro prepared to sail on the 5th, though we had intelligence that only a few hours previously an English squadron had been seen from the watch-tower of Sisarga, appearing to stand towards the mouth of the Tagus. Those who saw our ship weigh anchor asserted that we should be captured in three days, and that, forced to follow the fate of the vessel, we should be carried to Lisbon. This prognostic gave us the more uneasiness, as we had known some Mexicans at Madrid, who, in order to return to Vera Cruz, had embarked three times

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at Cadiz, and having been each time taken at the entrance of the port, were at length obliged to return to Spain through Portugal.

The Pizarro set sail at two in the afternoon. As the long and narrow passage by which a ship sails from the port of Corunna opens towards the north, and the wind was contrary, we made eight short tacks, three of which were useless. A fresh tack was made, but very slowly, and we were for some moments in danger at the foot of fort St. Amarro, the current having driven us very near the rock, on which the sea breaks with considerable violence. We remained with our eyes fixed on the castle of St. Antonio, where the unfortunate Malaspina was then a captive in a state prison. On the point of leaving Europe to visit the countries which this illustrious traveller had visited with so much advantage, I could have wished to have fixed my thoughts on some object less affecting.

At half-past six we passed the Tower of Hercules, which is the lighthouse of Corunna, as already mentioned, and where, from a very remote time, a coal-fire has been kept up for the direction of vessels. The light of this fire is in no way proportionate to the noble construction of so vast an edifice, being so feeble that ships cannot perceive it till they are in danger of striking on the shore. Towards the close of day the wind increased and the sea ran high. We directed our course to north-west, in order to avoid the English frigates, which we supposed were cruizing off these coasts. About nine we spied the light of a fishing-hut at Sisarga, which was the last object we beheld in the west of Europe.

On the 7th we were in the latitude of Cape Finisterre. The group of granitic rocks, which forms part of this promontory, like that of Toriañes and Monte de Corcubion, bears the name of the Sierra de Toriñona. Cape Finisterre is lower than the neighbouring lands, but the Toriñona is visible at seventeen leagues' distance, which proves that the elevation of its highest summit is not less than 300 toises (582 metres). Spanish navigators affirm that on these coasts the magnetic variation differs extremely from that observed at sea. M. Bory, it is true, in the voyage of the sloop Amaranth, found in 1751, that the variation of the

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needle determined at the Cape was four degrees less than could have been conjectured from the observations made at the same period along the coasts. In the same manner as the granite of Galicia contains tin disseminated in its mass, that of Cape Finisterre probably contains micaceous iron. In the mountains of the Upper Palatinate there are granitic rocks in which crystals of micaceous iron take the place of common mica.

On the 8th, at sunset, we descried from the mast-head an English convoy sailing along the coast, and steering towards south-east. In order to avoid it we altered our course during the night. From this moment no light was permitted in the great cabin, to prevent our being seen at a distance. This precaution, which was at the time prescribed in the regulations of the packet-ships of the Spanish navy, was extremely irksome to us during the voyages we made in the course of the five following years. We were constantly obliged to make use of dark-lanterns to examine the temperature of the water, or to read the divisions on the limb of the astronomical instruments. In the torrid zone, where twilight lasts but a few minutes, our operations ceased almost at six in the evening. This state of things was so much the more vexatious to me as from the nature of my constitution I never was subject to sea-sickness, and feel an extreme ardour for study during the whole time I am at sea.

On the 9th of June, in latitude 39° 50′, and longitude 16° 10′ west of the meridian of the observatory of Paris, we began to feel the effects of the great current which from the Azores flows towards the straits of Gibraltar and the Canary Islands. This current is commonly attributed to that tendency towards the east, which the straits of Gibraltar give to the waters of the Atlantic Ocean. M. de Fleurieu observes that the Mediterranean, losing by evaporation more water than the rivers can supply, causes a movement in the neighbouring ocean, and that the influence of the straits is felt at the distance of six hundred leagues. Without derogating from the respect I entertain for the opinion of that celebrated navigator, I may be permitted to consider this important object in a far more general point of view.

When we cast our eyes over the Atlantic, or that deep valley which divides the western coasts of Europe and Africa from the eastern coasts of the new world, we distinguish

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a contrary direction in the motion of the waters. Within the tropics, especially from the coast of Senegal to the Caribbean Sea, the general current, that which was earliest known to mariners, flows constantly from east to west. This is called the equinoctial current. Its mean rapidity, corresponding to different latitudes, is nearly the same in the Atlantic and in the Pacific, and may be estimated at nine or ten miles in twenty-four hours, consequently from 0·59 to 0·65 of a foot every second! In those latitudes the waters run towards the west with a velocity equal to a fourth of the rapidity of the greater part of the larger rivers of Europe. The movement of the ocean in a direction contrary to that of the rotation of the globe, is probably connected with this last phenomenon only as far as the rotation converts into trade winds* the polar winds, which, in the low regions of the atmosphere bring back the cold air of the high latitudes toward the equator. To the general impulsion which these trade-winds give the surface of the sea, we must attribute the equinoctial current, the force and rapidity of which are not sensibly modified by the local variations of the atmosphere.

In the channel which the Atlantic has dug between Guiana and Guinea, on the meridian of 20 or 23 degrees, and from the 8th or 9th to the 2nd or 3rd degrees of northern latitude, where the trade-winds are often interrupted by winds blowing from the south and south-south-west, the equinoctial current is more inconstant in its direction. Towards the coasts of Africa, vessels are drawn in the direction of south-east; whilst towards the Bay of All Saints and Cape St. Augustin, the coasts of which are dreaded by navigators sailing towards the mouth of the Plata, the general motion of the waters is masked by a particular current (the effects of which extend from Cape St. Roche to the Isle of Trinidad) running north-west with a mean velocity of a foot and a half every second.

The equinoctial current is felt, though feebly, even beyond the tropic of Cancer, in the 26th and 28th degrees of latitude. In the vast basin of the Atlantic, at six or seven hundred leagues from the coasts of Africa, vessels from Europe bound to the West Indies, find their sailing accele-

* The limits of the trade winds were, for the first time, determined by Dampier in 1666.

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rated before they reach the torrid zone. More to the north, in 28 and 35 degrees, between the parallels of Teneriffe and Ceuta, in 46 and 48 degrees of longitude, no constant motion is observed: there, a zone of 140 leagues in breadth separates the equinoctial current (the tendency of which is towards the west) from that great mass of water which runs eastward, and is distinguished for its extraordinary high temperature. To this mass of waters, known by the name of the Gulf-stream,* the attention of naturalists was directed in 1776 by the curious observations of Franklin and Sir Charles Blagden.

The equinoctial current drives the waters of the Atlantic towards the coasts inhabited by the Mosquito Indians, and towards the shores of Honduras. The New Continent, stretching from south to north, forms a sort of dyke to this current. The waters are carried at first north-west, and passing into the Gulf of Mexico through the strait formed by Cape Catoche and Cape St. Antonio, follow the bendings of the Mexican coast, from Vera Cruz to the mouth of the Rio del Norte, and thence to the mouths of the Mississippi, and the shoals west of the southern extremity of Florida. Having made this vast circuit west, north, east, and south, the current takes a new direction northward, and throws itself with impetuosity into the Gulf of Florida. At the end of the Gulf of Florida, in the parallel of Cape Cannaveral, the Gulf-stream, or current of Florida, runs north-east. Its rapidity resembles that of a torrent, and is sometimes five miles an hour. The pilot may judge, with some certainty, of the proximity of his approach to New York, Philadelphia, or Charlestown when he reaches the edge of the stream; for the elevated temperature of the waters, their saltness, indigo-blue colour, and the shoals of seaweed which cover their surface, as well as the heat of the surrounding atmosphere, all indicate the Gulf-stream. Its rapidity diminishes towards the north, at the same time that its breadth increases and the waters become cool. Between Cayo Biscaino and the bank of Bahama the breadth is only 15 leagues, whilst in the latitude of 28½ degrees, it is 17, and in the parallel of Charlestown, opposite Cape Henlopen, from 40

* Sir Francis Drake observed this extraordinary movement of the waters, but he was unacquainted with their high temperature.

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to 50 leagues. The rapidity of the current is from three to five miles an hour where the stream is narrowest, and is only one mile as it advances towards the north. The waters of the Mexican Gulf, forcibly drawn to north-east, preserve their warm temperature to such a point, that in 40 and 41 degrees of latitude I found them at 22·5° (18° R.) when, out of the current, the heat of the ocean at its surface was scarcely 17·5° (14° R.). In the parallel of New York and Oporto, the temperature of the Gulf-stream is consequently equal to that of the seas of the tropics in the 18th degree of latitude, as, for instance, in the parallel of Porto Rico and the islands of Cape Verd.

To the east of the port of Boston, and on the meridian of Halifax, in latitude 41° 25′, and longitude 67°, the current is near 80 leagues broad. From this point it turns suddenly to the east, so that its western edge, as it bends, becomes the western limit of the running waters, skirting the extremity of the great bank of Newfoundland, which M. Volney ingeniously calls the bar of the mouth of this enormous sea-river. The cold waters of this bank, which according to my experiments are at a temperature of 8·7° or 10° (7° or 8° R.) present a striking contrast with the waters of the torrid zone, driven northward by the Gulf-stream, the temperature of which is from 21° to 22·5° (17° to 18° R.). In these latitudes, the caloric is distributed in a singular manner throughout the ocean; the waters of the bank are 9·4° colder than the neighbouring sea; and this sea is 3° colder than the current. These zones can have no equilibrium of temperature, having a source of heat, or a cause of refrigeration, which is peculiar to each, and the influence of which is permanent.

From the bank of Newfoundland, or from the 52nd degree of longitude to the Azores, the Gulf-stream continues its course to east and east-south-east. The waters are still acted upon by the impulsion they received near a thousand leagues distance, in the straits of Florida, between the island of Cuba and the shoals of Tortoise Island. This distance is double the length of the course of the river Amazon, from Jaen or the straits of Manseriche to Grand Para. On the meridian of the islands of Corvo and Flores, the most western of the group of the Azores, the breadth of the current is

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160 leagues. When vessels, on their return from South America to Europe, endeavour to make these two islands to rectify their longitude, they are always sensible of the motion of the waters to south-east. At the 33rd degree of latitude the equinoctial current of the tropics is in the near vicinity of the Gulf-stream. In this part of the ocean, we may in a single day pass from waters that flow towards the west, into those which run to the south-east or east-south-east.

From the Azores, the current of Florida turns towards the straits of Gibraltar, the isle of Madeira, and the group of the Canary Islands. The opening of the Pillars of Hercules has no doubt accelerated the motion of the waters towards the east. We may in this point of view assert, that the strait, by which the Mediterranean communicates with the Atlantic, produces its effects at a great distance; but it is probable also, that, without the existence of this strait, vessels sailing to Teneriffe would be driven south-east by a cause which we must seek on the coasts of the New World. Every motion is the cause of another motion in the vast basin of the seas as well as in the aerial ocean. Tracing the currents to their most distant sources, and reflecting on their variable celerity, sometimes decreasing as between the gulf of Florida and the bank of Newfoundland; at other times augmenting, as in the neighbourhood of the straits of Gibraltar, and near the Canary Islands, we cannot doubt but the same cause which impels the waters to make the circuitous sweep of the gulf of Mexico, agitates them also near the island of Madeira.

On the south of that island, we may follow the current, in its direction S.E. and S.S.E. towards the coast of Africa, between Cape Cantin and Cape Bojador. In those latitudes a vessel becalmed is running on the coast, while, according to the uncorrected reckoning, it was supposed to be a good distance out at sea. Were the motion of the waters caused by the opening at the straits of Gibraltar, why, on the south of those straits, should it not follow an opposite direction? On the contrary, in the 25th and 26th degrees of latitude, the current flows at first direct south, and then south-west. Cape Blanc, which, after Cape Verd, is the most salient promontory, seems to have an influence

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on this direction, and in this parallel the waters, of which we have followed the course from the coasts of Honduras to those of Africa, mingle with the great current of the tropics to resume their tour from east to west. Several hundred leagues westward of the Canary Islands, the motion peculiar to the equinoctial waters is felt in the temperate zone from the 28th and 29th degrees of north latitude; but on the meridian of the island of Ferro, vessels sail southward as far as the tropic of Cancer, before they find themselves, by their reckoning, eastward of their right course.*

We have just seen that between the parallels of 11 and 43 degrees, the waters of the Atlantic are driven by the currents in a continual whirlpool. Supposing that a molecule of water returns to the same place from which it departed, we can estimate, from our present knowledge of the swiftness of currents, than this circuit of 3800 leagues is not terminated in less than two years and ten months. A boat, which may be supposed to receive no impulsion from the winds, would require thirteen months to go from the Canary Islands to the coast of Caracas, ten months to make the tour of the gulf of Mexico and reach Tortoise Shoals opposite the port of the Havannah, while forty or fifty days might be sufficient to carry it from the straits of Florida to the bank of Newfoundland. It would be difficult to fix the rapidity of the retrograde current from this bank to the shores of Africa; estimating the mean velocity of the waters at seven or eight miles in twenty-four hours, we may allow ten or eleven months for this last distance. Such are the effects of the slow but regular motion which agitates the waters of the Atlantic. Those of the river Amazon take nearly forty-five days to flow from Tomependa to Grand Para.

A short time before my arrival at Teneriffe, the sea had left in the road of Santa Cruz the trunk of a cedrela odorata covered with the bark. This American tree vegetates within the tropics, or in the neighbouring regions. It had no doubt been torn up on the coast of the continent, or of that of Honduras. The nature of the wood, and the lichens which covered its bark, bore evidence that this trunk had not belonged to these submarine forests which

* See Humboldt's *Cosmos*, vol. i., p. 312. Bohn's edition.

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ancient revolutions of the globe have deposited in the polar regions. If the cedrela, instead of having been cast on the strand of Teneriffe, had been carried farther south, it would probably have made the whole tour of the Atlantic, and returned to its native soil with the general current of the tropics. This conjecture is supported by a fact of more ancient date, recorded in the history of the Canaries by the abbé Viera. In 1770, a small vessel laden with corn, and bound from the island of Lancerota, to Santa Cruz, in Teneriffe, was driven out to sea, while none of the crew were on board. The motion of the waters from east to west, carried it to America, where it went on shore at La Guayra, near Caracas.

Whilst the art of navigation was yet in its infancy, the Gulf-stream suggested to the mind of Christopher Columbus certain indications of the existence of western regions. Two corpses, the features of which indicated a race of unknown men, were cast ashore on the Azores, towards the end of the 15th century. Nearly at the same period, the brother-in-law of Columbus, Peter Correa, governor of Porto Santo, found on the strand of that island pieces of bamboo of extraordinary size, brought thither by the western currents. The dead bodies and the bamboos attracted the attention of the Genoese navigator, who conjectured that both came from a continent situate towards the west. We now know that in the torrid zone the trade-winds and the current of the tropics are in opposition to every motion of the waves in the direction of the earth's rotation. The productions of the new world cannot reach the old but by the very high latitudes, and in following the direction of the current of Florida. The fruits of several trees of the Antilles are often washed ashore on the coasts of the islands of Ferro and Gomera. Before the discovery of America, the Canarians considered these fruits as coming from the enchanted isle of St. Borondon, which according to the reveries of pilots, and certain legends, was situated towards the west in an unknown part of the ocean, buried, as was supposed, in eternal mists.

My chief view in tracing a sketch of the currents of the Atlantic is to prove that the motion of the waters towards the south-east, from Cape St. Vincent to the Canary Islands,

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is the effect of the general motion to which the surface of the ocean is subjected at its western extremity. We shall give but a very succinct account of the arm of the Gulf-stream, which in the 45th and 50th degrees of latitude, near the bank called the Bonnet Flamand, runs from south-west to north-east towards the coasts of Europe. This partial current becomes very strong at those times when the west winds are of long continuance: and, like that which flows along the isles of Ferro and Gomera, it deposits every year on the western coasts of Ireland and Norway the fruit of trees which belong to the torrid zone of America. On the shores of the Hebrides, we collect seeds of Mimosa scandens, of Dolichos urens, of Guilandina bonduc, and several other plants of Jamaica, the isle of Cuba, and of the neighbouring continent. The current carries thither also barrels of French wine, well preserved, the remains of the cargoes of vessels wrecked in the West Indian seas. To these examples of the distant migration of the vegetable world, others no less striking may be added. The wreck of an English vessel, the Tilbury, burnt near Jamaica, was found on the coast of Scotland. On these same coasts are sometimes found various kinds of tortoises, that inhabit the waters of the Antilles. When the western winds are of long duration, a current is formed in the high latitudes, which runs directly towards east-south-east, from the coasts of Greenland and Labrador, as far as the north of Scotland. Wallace relates, that twice (in 1682 and 1684), American savages of the race of the Esquimaux, driven out to sea in their leathern canoes, during a storm, and left to the guidance of the currents, reached the Orkneys. This last example is the more worthy of attention, as it proves at the same time how, at a period when the art of navigation was yet in its infancy, the motion of the waters of the ocean may have contributed to disseminate the different races of men over the face of the globe.

In reflecting on the causes of the Atlantic currents, we find that they are much more numerous than is generally believed; for the waters of the sea may be put in motion by an external impulse, by difference of heat and saltness, by the periodical melting of the polar ice, or by the inequality of evaporation, in different latitudes. Sometimes several of these causes concur to one and the same effect, and some-

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times they produce several contrary effects. Winds that are light, but which, like the trade-winds, are continually acting on the whole of a zone, cause a real movement of transition, which we do not observe in the heaviest tempests, because these last are circumscribed within a small space. When, in a great mass of water, the particles at the surface acquire a different specific gravity, a superficial current is formed, which takes its direction towards the point where the water is coldest, or where it is most saturated with muriate of soda, sulphate of lime, and muriate or sulphate of magnesia. In the seas of the tropics we find, that at great depths the thermometer marks 7 or 8 centesimal degrees. Such is the result of the numerous experiments of commodore Ellis and of M. Peron. The temperature of the air in those latitudes being never below 19 or 20 degrees, it is not at the surface that the waters can have acquired a degree of cold so near the point of congelation, and of the maximum of the density of water. The existence of this cold stratum in the low latitudes is an evident proof of the existence of an under-current, which runs from the poles towards the equator: it also proves that the saline substances which alter the specific gravity of the water, are distributed in the ocean, so as not to annihilate the effect produced by the differences of temperature.

Considering the velocity of the molecules, which, on account of the rotatory motion of the globe, vary with the parallels, we may be tempted to admit that every current, in the direction from south to north, tends at the same time eastward, while the waters which run from the pole towards the equator, have a tendency to deviate westward. We may also be led to think that these tendencies diminish to a certain point the speed of the tropical current, in the same manner as they change the direction of the polar current, which in July and August, is regularly perceived during the melting of the ice, on the parallel of the bank of Newfoundland, and farther north. Very old nautical observations, which I have had occasion to confirm by comparing the longitude given by the chronometer with that which the pilots obtained by their reckoning, are, however, contrary to these theoretical ideas. In both hemispheres, the polar currents, when they are perceived, decline a little to the

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east; and it would seem that the cause of this phenomenon should be sought in the constancy of the westerly winds which prevail in the high latitudes. Besides, the particles of water do not move with the same rapidity as the particles of air; and the currents of the ocean, which we consider as most rapid, have only a swiftness of eight or nine feet a second; it is consequently very probable, that the water, in passing through different parallels, gradually acquires a velocity correspondent to those parallels, and that the rotation of the earth does not change the direction of the currents.

The variable pressure on the surface of the sea, caused by the changes in the weight of the air, is another cause of motion which deserves particular attention. It is well known, that the barometric variations do not in general take place at the same moment in two distant points, which are on the same level. If in one of these points the barometer stands a few lines lower than in the other, the water will rise where it finds the least pressure of air, and this local intumescence will continue, till, from the effect of the wind, the equilibrium of the air is restored. M. Vaucher thinks that the tides in the lake of Geneva, known by the name of the *seiches*, arise from the same cause. We know not whether it be the same, when the movement of progression, which must not be confounded with the oscillation of the waves, is the effect of an external impulse. M. de Fleurieu, in his narrative of the voyage of the Isis, cites several facts, which render it probable that the sea is not so still at the bottom as naturalists generally suppose. Without entering here into a discussion of this question, we shall only observe that, if the external impulse is constant in its action, like that of the trade-winds, the friction of the particles of water on each other must necessarilly propagate the motion of the surface of the ocean even to the lower strata; and in fact this propagation in the Gulf-stream has long been admitted by navigators, who think they discover the effects in the great depth of the sea wherever it is traversed by the current of Florida, even amidst the sand-banks which surround the northern coasts of the United States. This immense river of hot waters, after a course of fifty days, from the 24th to the 45th degree of latitude, or 450 leagues, does not lose,

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amidst the rigours of winter in the temperate zone, more than 3 or 4 degrees of the temperature it had under the tropics. The greatness of the mass, and the small conductibility of water for heat, prevent a more speedy refrigeration. If, therefore, the Gulf-stream has dug a channel at the bottom of the Atlantic ocean, and if its waters are in motion to considerable depths, they must also in their inferior strata keep up a lower temperature than that observed in the same parallel, in a part of the sea which has neither currents nor deep shoals. These questions can be cleared up only by direct experiments, made by thermometrical soundings.

Sir Erasmus Gower remarks, that, in the passage from England to the Canary islands, the current, which carries vessels towards the south-east, begins at the 39th degree of latitude. During our voyage from Corunna to the coast of South America, the effect of this motion of the waters was perceived farther north. From the 37th to the 30th degree, the deviation was very unequal; the daily average effect was 12 miles, that is, our sloop drove towards the east 75 miles in six days. In crossing the parallel of the straits of Gibraltar, at a distance of 140 leagues, we had occasion to observe, that in those latitudes the maximum of the rapidity does not correspond with the mouth of the straits, but with a more northerly point, which lies on the prolongation of a line passing through the strait and Cape St. Vincent. This line is parallel to the direction which the waters follow from the Azores to Cape Cantin. We should moreover observe (and this fact is not uninteresting to those who examine the nature of fluids), that in this part of the retrograde current, on a breadth of 120 or 140 leagues, the whole mass of water has not the same rapidity, nor does it follow precisely the same direction. When the sea is perfectly calm, there appears at the surface narrow stripes, like small rivulets, in which the waters run with a murmur very sensible to the ear of an experienced pilot. On the 13th of June, in 34° 36′ north latitude, we found ourselves in the midst of a great number of these beds of currents. We took their direction with the compass; and some ran north-east, others east-north-east, though the general movement of the ocean, indicated by comparing the reckoning with the chronometrical longitude, continued to be south-east. It

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is very common to see a mass of motionless waters crossed by threads of water, which run in different directions, and we may daily observe this phenomenon on the surface of lakes; but it is much less frequent to find partial movements, impressed by local causes on small portions of waters in the midst of an oceanic river, which occupies an immense space, and which moves, though slowly, in a constant direction. In the conflict of currents, as in the oscillation of the waves, our imagination is struck by those movements which seem to penetrate each other, and by which the ocean is continually agitated.

We passed Cape St. Vincent, which is of basaltic formation, at the distance of more than eighty leagues. It is not distinctly seen at a greater distance than 15 leagues, but the granitic mountain called the Foya de Monchique, situated near the Cape, is perceptible, as pilots allege, at the distance of 26 leagues. If this assertion be exact, the Foya is 700 toises (1363 metres), and consequently 116 toises (225 metres) higher than Vesuvius.

From Corunna to the 36th degree of latitude we had scarcely seen any organic being, excepting sea-swallows and a few dolphins. We looked in vain for sea-weeds (fuci) and mollusca, when on the 11th of June we were struck with a curious sight which afterwards was frequently renewed in the southern ocean. We entered on a zone where the whole sea was covered with a prodigious quantity of medusas. The vessel was almost becalmed, but the mollusca were borne towards the south-east, with a rapidity four times greater than the current. Their passage lasted near three quarters of an hour. We then perceived but a few scattered individuals, following the crowd at a distance as if tired with their journey. Do these animals come from the bottom of the sea, which is perhaps in these latitudes some thousand fathoms deep? or do they make distant voyages in shoals? We know that the mollusca haunt banks; and if the eight rocks, near the surface, which captain Vobonne mentions having seen in 1732, to the north of Porto Santo, really exist, we may suppose that this innumerable quantity of medusas had been thence detached; for we were but 28 leagues from the reef. We found, beside the Medusa aurita of Baster, and the Medusa pelagica of

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Bosc with eight tentacula (Pelagia denticulata, Péron), a third species which resembles the Medusa hysocella, and which Vandelli found at the mouth of the Tagus. It is known by its brownish-yellow colour, and by its tentacula, which are longer than the body. Several of these sea-nettles were four inches in diameter: their reflection was almost metallic: their changeable colours of violet and purple formed an agreeable contrast with the azure tint of the ocean.

In the midst of these medusas M. Bonpland observed bundles of Dagysa notata, a mollusca of a singular construction, which Sir Joseph Banks first discovered. These are small gelatinous bags, transparent, cylindrical, sometimes polygonal, thirteen lines long and two or three in diameter. These bags are open at both ends. In one of these openings, we observed a hyaline bladder, marked with a yellow spot. The cylinders lie longitudinally, one against another, like the cells of a bee-hive, and form chaplets from six to eight inches in length. I tried the galvanic electricity on these mollusca, but it produced no contraction. It appears that the genus dagysa, formed at the time of Cook's first voyage, belongs to the salpas (biphores of Bruguière), to which M. Cuvier joins the Thalia of Brown, and the Tethys vagina of Tilesius. The salpas journey also by groups, joining in chaplets, as we have observed of the dagysa.

On the morning of the 13th of June, in 34° 33′ latitude, we saw large masses of this last mollusca in its passage, the sea being perfectly calm. We observed during the night, that, of three species of medusas which we collected, none yielded any light but at the moment of a very slight shock. This property does not belong exclusively to the Medusa noctiluca, which Forskæl has described in his Fauna Ægyptiaca, and which Gmelin has applied to the Medusa pelagica of Lœfling, notwithstanding its red tentacula, and the brownish tuberosities of its body. If we place a very irritable medusa on a pewter plate, and strike against the plate with any sort of metal, the slight vibrations of the plate are sufficient to make this animal emit light. Sometimes, in galvanising the medusa, the phosphorescence appears at the moment that the chain closes, though the exciters are not in immediate contact with the organs of the animal. The fingers with

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which we touch it remain luminous for two or three minutes, as is observed in breaking the shell of the pholades. If we rub wood with the body of a medusa, and the part rubbed ceases shining, the phosphorescence returns if we pass a dry hand over the wood. When the light is extinguished a second time, it can no longer be reproduced, though the place rubbed be still humid and viscous. In what manner ought we to consider the effect of the friction, or that of the shock? This is a question of difficult solution. Is it a slight augmentation of temperature which favours the phosphorescence? or does the light return, because the surface is renewed, by putting the animal parts proper to disengage the phosphoric hydrogen in contact with the oxygen of the atmospheric air? I have proved by experiments published in 1797, that the shining of wood is extinguished in hydrogen gas, and in pure azotic gas, and that its light reappears whenever we mix with it the smallest bubble of oxygen gas. These facts, to which several others may be added, tend to explain the causes of the phosphorescence of the sea, and of that peculiar influence which the shock of the waves exercises on the production of light.

When we were between the island of Madeira and the coast of Africa, we had slight breezes and dead calms, very favourable for the magnetic observations, which occupied me during this passage. We were never weary of admiring the beauty of the nights; nothing can be compared to the transparency and serenity of an African sky. We were struck with the innumerable quantity of falling stars, which appeared at every instant. The farther progress we made towards the south, the more frequent was this phenomenon, especially near the Canaries. I have observed during my travels, that these igneous meteors are in general more common and luminous in some regions of the globe than in others; but I have never beheld them so multiplied as in the vicinity of the volcanoes of the province of Quito, and in that part of the Pacific ocean which bathes the volcanic coasts of Guatimala. The influence which place, climate, and season appear to exercise on the falling stars, distinguishes this class of meteors from those to which we trace stones that drop from the sky (aërolites), and which probably exist beyond the boundaries of our atmosphere. According to

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the observations of Messrs. Benzenberg and Brandes, many of the falling stars seen in Europe have been only thirty thousand toises high. One was even measured which did not exceed fourteen thousand toises, or five nautical leagues. These measures, which can give no result but by approximation, deserve well to be repeated. In warm climates, especially within the tropics, falling stars leave a tail behind them, which remains luminous 12 or 15 seconds: at other times they seem to burst into sparks, and they are generally lower than those in the north of Europe. We perceive them only in a serene and azure sky; they have perhaps never been below a cloud. Falling stars often follow the same direction for several hours, which direction is that of the wind. In the bay of Naples, M. Gay-Lussac and myself observed luminous phenomena very analogous to those which fixed my attention during a long abode at Mexico and Quito. These meteors are perhaps modified by the nature of the soil and the air, like certain effects of the looming or mirage, and of the terrestial refraction peculiar to the coasts of Calabria and Sicily.

When we were forty leagues east of the island of Madeira, a swallow* perched on the topsail-yard. It was so fatigued, that it suffered itself to be easily taken. It was remarkable that a bird, in that season, and in calm weather, should fly so far. In the expedition of d'Entrecasteaux, a common swallow was seen 60 leagues distant from Cape Blanco; but this was towards the end of October, and M. Labillardière thought it had newly arrived from Europe. We crossed these latitudes in June, at a period when the seas had not for a long time been agitated by tempests. I mention this last circumstance, because small birds and even butterflies, are sometimes forced out to sea by the impetuosity of the winds, as we observed in the Pacific ocean, when we were on the western coast of Mexico.

The Pizarro had orders to touch at the isle of Lancerota, one of the seven great Canary Islands; and at five in the afternoon of the 16th of June, that island appeared so distinctly in view that I was able to take the angle of altitude of a conic mountain, which towered majestically over the

* Hirundo rustica, *Linn.*

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other summits, and which we thought was the great volcano which had occasioned such devastation on the night of the 1st of September, 1730.

The current drew us toward the coast more rapidly than we wished. As we advanced, we discovered at first the island of Forteventura, famous for its numerous camels;* and a short time after we saw the small island of Lobos in the channel which separates Forteventura from Lancerota. We spent part of the night on deck. The moon illumined the volcanic summits of Lancerota, the flanks of which, covered with ashes, reflected a silver light. Antares threw out its resplendent rays near the lunar disk, which was but a few degrees above the horizon. The night was beautifully serene and cool. Though we were but a little distance from the African coast, and on the limit of the torrid zone, the centigrade thermometer rose no higher than 18°. The phosphorescence of the ocean seemed to augment the mass of light diffused through the air. After midnight, great black clouds rising behind the volcano shrouded at intervals the moon and the beautiful constellation of the Scorpion. We beheld lights carried to and fro on shore, which were probably those of fishermen preparing for their labours. We had been occasionally employed, during our passage, in reading the old voyages of the Spaniards, and these moving lights recalled to our fancy those which Pedro Gutierrez, page of Queen Isabella, saw in the isle of Guanahani, on the memorable night of the discovery of the New World.

On the 17th, in the morning, the horizon was foggy, and the sky slightly covered with vapour. The outlines of the mountains of Lancerota appeared stronger: the humidity, increasing the transparency of the air, seemed at the same time to have brought the objects nearer our view. This phenomenon is well known to all who have made hygrome-

* These camels, which serve for labour, and sometimes for food, did not exist till the Béthencourts made the conquest of the Canaries. In the sixteenth century, asses were so abundant in the island of Forteventura, that they became wild and were hunted. Several thousands were killed to save the harvest. The horses of Forteventura are of singular beauty, and of the Barbary race.—"Noticias de la Historia General de las Islas Canarias," por Don José de Viera, tom. 2, p. 436.

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trical observations in places whence the chain of the Higher Alps or of the Andes is seen. We passed through the channel which divides the isle of Alegranza from Montaña Clara, taking soundings the whole way; and we examined the archipelago of small islands situated northward of Lancerota. In the midst of this archipelago, which is seldom visited by vessels bound for Teneriffe, we were singularly struck with the configuration of the coasts. We thought ourselves transported to the Euganean mountains in the Vicentin, or the banks of the Rhine near Bonn. The form of organized beings varies according to the climate, and it is that extreme variety which renders the study of the geography of plants and animals so attractive; but rocks, more ancient perhaps than the causes which have produced the difference of the climate on the globe, are the same in both hemispheres. The porphyries containing vitreous feldspar and hornblende, the phonolite, the greenstone, the amygdaloids, and the basalt, have forms almost as invariable as simple crystallized substances. In the Canary Islands, and in the mountains of Auvergne, in the Mittelgebirge in Bohemia, in Mexico, and on the banks of the Ganges, the formation of trap is indicated by a symmetrical disposition of the mountains, by truncated cones, sometimes insulated, sometimes grouped, and by elevated plains, both extremities of which are crowned by a conical rising.

The whole western part of Lancerota, of which we had a near view, bears the appearance of a country recently convulsed by volcanic eruptions. Everything is black, parched, and stripped of vegetable mould. We distinguished, with our glasses, stratified basalt in thin and steeply-sloping strata. Several hills resembled the Monte Novo, near Naples, or those hillocks of scoria and ashes which the opening earth threw up in a single night at the foot of the volcano of Jorullo, in Mexico. In fact, the abbé Viera relates, that in 1730, more than half the island changed its appearance. The great volcano, which we have just mentioned, and which the inhabitants call the volcano of Temanfaya, spread desolation over a most fertile and highly cultivated region: nine villages were entirely destroyed by the lavas. This catastrophe had been preceded by a tremendous earthquake, and

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for several years shocks equally violent were felt. This last phenomenon is so much the more singular, as it seldom happens after an eruption, when the elastic vapours have found vent by the crater, after the ejection of the melted matter. The summit of the great volcano is a rounded hill, but not entirely conic. From the angles of altitude which I took at different distances, its absolute elevation did not appear to exceed three hundred toises. The neighbouring hills, and those of Alegranza and Isla Clara, were scarcely above one hundred or one hundred and twenty toises. We may be surprised at the small elevation of these summits, which, viewed from the sea, wear so majestic a form; but nothing is more uncertain than our judgment on the greatness of angles, which are subtended by objects close to the horizon. From illusions of this sort it arose, that before the measures of Messrs. de Churruca and Galleano, at Cape Pilar, navigators considered the mountains of the straits of Magellan, and those of Terra del Fuego, to be extremely elevated.

The island of Lancerota bore formerly the name of Titeroigotra. On the arrival of the Spaniards, its inhabitants were distinguished from the other Canarians by marks of greater civilization. Their houses were built with freestone, while the Guanches of Teneriffe dwelt in caverns. At Lancerota, a very singular custom prevailed at that time, of which we find no example except among the people of Thibet. A woman had several husbands, who alternately enjoyed the prerogatives due to the head of a family. A husband was considered as such only during a lunar revolution, and whilst his rights were exercised by others, he remained classed among the household domestics. In the fifteenth century the island of Lancerota contained two small distinct states, divided by a wall; a kind of monument which outlives national enmities, and which we find in Scotland, in China, and Peru.

We were forced by the winds to pass between the islands of Alegranza and Montaña Clara, and as none on board the sloop had sailed through this passage, we were obliged to be continually sounding. We found from twenty-five to thirty-two fathoms. The lead brought up an organic substance of

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so singular a structure that we were for a long time doubtful whether it was a zoophyte or a kind of seaweed. The stem, of a brownish colour and three inches long, has circular leaves with lobes, and indented at the edges. The colour of these leaves is a pale green, and they are membranous and streaked like those of the adiantums and Gingko biloba. Their surface is covered with stiff whitish hairs; before their opening they are concave, and enveloped one in the other. We observed no mark of spontaneous motion, no sign of irritability, not even on the application of galvanic electricity. The stem is not woody, but almost of a horny substance, like the stem of the Gorgons. Azote and phosphorus having been abundantly found in several cryptogamous plants, an appeal to chemistry would be useless to determine whether this organized substance belonged to the animal or vegetable kingdom. Its great analogy to several sea-plants, with adiantum leaves, especially the genus caulerpa of M. Lamoureux, of which the Fucus proliter of Forskael is one of the numerous species, engaged us to rank it provisionally among the sea-wracks, and give it the name of Fucus vitifolius. The bristles which cover this plant are found in several other fuci.* The leaf, examined with a microscope at the instant we drew it up from the water, did not present, it is true, those conglobate glands, or those opaque points, which the parts of fructification in the genera of ulva and fucus contain; but how often do we find seaweeds in such a state that we cannot yet distinguish any trace of seeds in their transparent parenchyma.

The vine-leaved fucus presents a physiological phenomenon of the greatest interest. Fixed to a piece of madrepore, this seaweed vegetates at the bottom of the ocean, at the depth of 192 feet, notwithstanding which we found its leaves as green as those of our grasses. According to the experiments of Bouguer, light is weakened after a passage of 180 feet in the ratio of 1 to 1477·8. The seaweed of Alegranza consequently presents a new example of plants which vegetate in great obscurity without becoming white. Several germs, enveloped in the bulbs of the lily tribes, the embryo of the malvaceæ, of the rhamnoïdes, of the pistacea, the viscum, and the citrus, the branches of some subterraneous plants;

* Fucus lycopodioïdes, and F. hirsutus.

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in short, vegetables transported into mines, where the ambient air contains hydrogen or a great quantity of azote, become green without light. From these facts we are inclined to admit that it is not exclusively by the influence of the solar rays that this carburet of hydrogen is formed in the organs of plants, the presence of which makes the parenchyma appear of a lighter or darker green, according as the carbon predominates in the mixture.

Mr. Turner, who has so well made known the family of the seaweeds, as well as many other celebrated botanists, are of opinion that most of the fuci which we gather on the surface of the ocean, and which, from the 23rd to the 35th degree of latitude and 32nd of longitude, appear to the mariner like a vast inundated meadow, grow primitively at the bottom of the ocean, and float only in their ripened state, when torn up by the motion of the waves. If this opinion be well founded, we must agree that the family of seaweeds offers formidable difficulties to naturalists, who persist in thinking that absence of light always produces whiteness; for how can we admit that so many species of ulvaceæ and dictyoteæ, with stems and green leaves, which float on the ocean, have vegetated on rocks near the surface of the water?

From some notions which the captain of the Pizarro had collected in an old Portuguese itinerary, he thought himself opposite to a small fort, situated north of Teguisa, the capital of the island of Lancerota. Mistaking a rock of basalt for a castle, he saluted it by hoisting the Spanish flag, and sent a boat with an officer to inquire of the commandant whether any English vessels were cruizing in the roads. We were not a little surprised to learn that the land which we had considered as a prolongation of the coast of Lancerota, was the small island of Graciosa, and that for several leagues there was not an inhabited place. We took advantage of the boat to survey the land, which enclosed a large bay.

The small part of the island of Graciosa which we traversed, resembles those promontories of lava seen near Naples, between Portici and Torre del Greco. The rocks are naked, with no marks of vegetation, and scarcely any of vegetable soil. A few crustaceous lichen-like variolariæ, lepрariæ, and urceolariæ, were scattered about upon the basalts. The lavas which are not covered with volcanic ashes remain for ages

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without any appearance of vegetation. On the African soil excessive heat and lengthened drought retard the growth of cryptogamous plants.

The basalts of Graciosa are not in columns, but are divided into strata ten or fifteen inches thick. These strata are inclined at an angle of 80 degrees to the north-west. The compact basalt alternates with the strata of porous basalt and marl. The rock does not contain hornblende, but great crystals of foliated olivine, which have a triple cleavage.* This substance is decomposed with great difficulty. M. Haüy considers it a variety of the pyroxene. The porous basalt, which passes into mandelstein, has oblong cavities from two to eight lines in diameter, lined with chalcedony, enclosing fragments of compact basalt. I did not remark that these cavities had the same direction, or that the porous rock lay on compact strata, as happens in the currents of lava of Etna and Vesuvius. The marl,† which alternates more than a hundred times with the basalts, is yellowish, friable by decomposition, very coherent in the inside, and often divided into irregular prisms, analogous to the basaltic prisms. The sun discolours their surface, as it whitens several schists, by reviving a hydro-carburetted principle, which appears to be combined with the earth. The marl of Graciosa contains a great quantity of chalk, and strongly effervesces with nitric acid, even on points where it is found in contact with the basalt. This fact is the more remarkable, as this substance does not fill the fissures of the rock, but its strata are parallel to those of the basalt; whence we may conclude that both fossils are of the same formation, and have a common origin. The phenomenon of a basaltic rock containing masses of indurated marl split into small columns, is also found in the Mittelgebirge, in Bohemia. Visiting those countries in 1792, in company with Mr. Freiesleben, we even recognized in the marl of the Stiefelberg the imprint of a plant nearly resembling the Cerastium, or the Alsine. Are these strata, contained in the trappean mountains, owing to muddy irruptions, or must we consider them as sediments of water, which alternate with volcanic deposits? This last hypothesis seems so much the less admissible, since, from the

* Blættriger olivin. † Mergel.

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researches of Sir James Hall on the influence of pressure in fusions, the existence of carbonic acid in substances contained in basalt presents nothing surprising. Several lavas of Vesuvius present similar phenomena. In Lombardy, between Vicenza and Albano, where the calcareous stone of the Jura contains great masses of basalt, I have seen the latter enter into effervescence with the acids wherever it touches the calcareous rock.

We had not time to reach the summit of a hill very remarkable for having its base formed of banks of clay under strata of basalt, like a mountain in Saxony, called the Scheibenbergen Hügel, which is become celebrated on account of the disputes of volcanean and neptunean geologists. These basalts were covered with a mammiform substance, which I vainly sought on the Peak of Teneriffe, and which is known by the names of volcanic glass, glass of Muller, or hyalite: it is the transition from the opal to the chalcedony. We struck off with difficulty some fine specimens, leaving masses that were eight or ten inches square untouched. I never saw in Europe such fine hyalites as I found in the island of Graciosa, and on the rock of porphyry called *el Peñol de los Baños*, on the bank of the lake of Mexico.

Two kinds of sand cover the shore; one is black and basaltic, the other white and quartzose. In a place exposed to the rays of the sun, the first raised the thermometer to 51·2° (41° R.) and the second to 40° (32° R.) The temperature of the air in the shade was 27·7° or 7·5°. higher than that of the air over the sea. The quartzose sand contains fragments of feldspar. It is thrown back by the water, and forms, in some sort, on the surface of the rocks, small islets on which seaweed vegetates. Fragments of granite have been observed at Teneriffe; the island of Gomora, from the details furnished me by M. Broussonnet, contains a nucleus of micaceous schist:—the quartz disseminated in the sand, which we found on the shore of Graciosa, is a different substance from the lavas and the trappean porphyries so intimately connected with volcanic productions. From these facts it seems to be evident that in the Canary Islands, as well as on the Andes of Quito, in Auvergne, in Greece, and throughout the greater part of

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the globe, subterraneous fires have pierced through the rocks of primitive formation. In treating hereafter of the great number of warm springs which we have seen issuing from granite, gneiss, and micaceous schist, we shall have occasion to return to this subject, which is one of the most important of the physical history of the globe.

We re-embarked at sunset, and hoisted sail, but the breeze was too feeble to permit us to continue our course to Teneriffe. The sea was calm; a reddish vapour covered the horizon, and seemed to magnify every object. In this solitude, amidst so many uninhabited islets, we enjoyed for a long time the view of rugged and wild scenery. The black mountains of Graciosa appeared like perpendicular walls five or six hundred feet high. Their shadows, thrown over the surface of the ocean, gave a gloomy aspect to the scenery. Rocks of basalt, emerging from the bosom of the waters, wore the resemblance of the ruins of some vast edifice, and carried our thoughts back to the remote period when submarine volcanoes gave birth to new islands, or rent continents asunder. Every thing which surrounded us seemed to indicate destruction and sterility; but the back-ground of the picture, the coasts of Lancerota presented a more smiling aspect. In a narrow pass between two hills, crowned with scattered tufts of trees, marks of cultivation were visible. The last rays of the sun gilded the corn ready for the sickle. Even the desert is animated wherever we can discover a trace of the industry of man.

We endeavoured to get out of this bay by the pass which separates Alegranza from Montaña Clara, and through which we had easily entered to land at the northern point of Graciosa. The wind having fallen, the currents drove us very near a rock, on which the sea broke with violence, and which is noted in the old charts under the name of Hell, or Infierno. As we examined this rock at the distance of two cables' length, we found that it was a mass of lava three or four toises high, full of cavities, and covered with scoriæ resembling coke. We may presume that this rock,* which

* I must here observe, that this rock is noted on the celebrated Venetian chart of Andrea Bianco, but that the name of Infierno is given, as in the more ancient chart of Picigano, made in 1367, to Teneriffe, without

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modern charts call the West Rock (Roca del Oeste), was raised by volcanic fire; and it might heretofore have been much higher; for the new island of the Azores, which rose from the sea at successive periods, in 1638 and 1719, had reached 354 feet when it totally disappeared in 1723, to the depth of 480 feet. This opinion on the origin of the basaltic mass of the Infierno is confirmed by a phenomenon, which was observed about the middle of the last century in these same latitudes. At the time of the eruption of the volcano of Temanfaya, two pyramidal hills of lithoid lava rose from the bottom of the ocean, and gradually united themselves with the island of Lancerota.

As we were prevented by the fall of the wind, and by the currents, from repassing the channel of Alegranza, we resolved on tacking during the night between the island of Clara and the West Rock. This resolution had nearly proved fatal. A calm is very dangerous near this rock, towards which the current drives with considerable force. We began to feel the effects of this current at midnight. The proximity of the stony masses, which rise perpendicularly above the water, deprived us of the little wind which blew: the sloop no longer obeyed the helm, and we dreaded striking every instant. It is difficult to conceive how a mass of basalt, insulated in the vast expanse of the ocean, can cause so considerable a motion of the waters. These phenomena, worthy the attention of naturalists, are well known to mariners; they are extremely to be dreaded in the Pacific ocean, particularly in the small archipelago of the islands of Gallipagos. The difference of temperature which exists between the fluid and the mass of rocks does not explain the direction which these currents take; and how can we admit that the water is engulfed at the base of these rocks, (which often are not of volcanic origin) and that this continual engulfing determines the particles of water to fill up the vacuum that takes place.

The wind having freshened a little towards the morning on the 18th, we succeeded in passing the channel. We drew very near the Infierno the second time, and remarked the large crevices, through which the gaseous fluids probably

doubt because the Guanches considered the peak as the entrance into hell. In the same latitudes an island made its appearance in 1811.

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issued, when this basaltic mass was raised. We lost sight of the small islands of Alegranza, Montaña Clara, and Graciosa, which appear never to have been inhabited by the Guanches. They are now visited only for the purpose of gathering archil, which production is, however, less sought after, since so many other lichens of the north of Europe have been found to yield materials proper for dyeing. Montaña Clara is noted for its beautiful canary-birds. The note of these birds varies with their flocks, like that of our chaffinches, which often differs in two neighbouring districts. Montaña Clara yields pasture for goats, a fact which proves that the interior of this islet is less arid than its coasts. The name of Alegranza is synonymous with the Joyous, (La Joyeuse,) which denomination it received from the first conquerors of the Canary Islands, the two Norman barons, Jean de Béthencourt and Gadifer de Salle. This was the first point on which they landed. After remaining several days at Graciosa, a small part of which we examined, they conceived the project of taking possession of the neighbouring island of Lancerota, where they were welcomed by Guadarfia, sovereign of the Guanches, with the same hospitality that Cortez found in the palace of Montezuma. The shepherd king, who had no other riches than his goats, became the victim of base treachery, like the sultan of Mexico.

We sailed along the coasts of Lancerota, of the island of Lobos, and of Forteventura. The second of these islands seems to have anciently formed part of the two others. This geological hypothesis was started in the seventeenth century by the Franciscan, Juan Galindo. That writer supposed that king Juba had named six Canary Islands only, because, in his time, three among them were contiguous. Without admitting the probability of this hypothesis, some learned geographers have imagined they recognized, in the two islands Nivaria and Ombrios, the Canaria and Capraria of the ancients.

The haziness of the horizon prevented us, during the whole of our passage from Lancerota to Teneriffe, from discovering the summit of the peak of Teyde. If the height of this volcano is 1905 toises, as the last trigonometrical measure of Borda indicates, its summit ought to be visible at a distance of 43 leagues, supposing the eye on a level

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with the ocean, and a refraction equal to 0·079 of distance. It has been doubted whether the peak has ever been seen from the channel which separates Lancerota from Forteventura, and which is distant from the volcano, according to the chart of Varela, 2° 29′, or nearly 50 leagues. This phenomenon appears nevertheless to have been verified by several officers of the Spanish navy. I had in my hand, on board the Pizarro, a journal, in which it was noted, that the peak of Teneriffe had been seen at 135 miles distance, near the southern cape of Lancerota, called Pichiguera. Its summit was discovered under an angle considerable enough to lead the observer, Don Manual Baruti, to conclude that the volcano might have been visible at nine miles farther. It was in September, towards evening, and in very damp weather. Reckoning fifteen feet for the elevation of the eye, I find, that to render an account of this phenomenon, we must suppose a refraction equal to 0·158 of the arch, which is not very extraordinary for the temperate zone. According to the observations of General Roy, the refractions vary in England from one-twentieth to one-third; and if it be true that they reach these extreme limits on the coast of Africa, (which I much doubt,) the peak, in certain circumstances, may be seen on the deck of a vessel as far off as 61 leagues.

Navigators who have much frequented these latitudes, and who can reflect on the physical causes of the phenomena, are surprised that the peaks of Teyde and of the Azores* are sometimes visible at a very great distance, though at other times they are not seen when the distance is much less, and the sky appears serene and the horizon free from fogs. These circumstances are the more worthy

* The height of this peak of the Azores, according to Fleurieu, is 1,100 toises; to Ferrer, 1,238 toises; and to Tofino, 1,260 toises: but these measures are only approximative estimates. The captain of the Pizarro, Don Manuel Cagigal, proved to me, by his journal, that he observed the peak of the Azores at the distance of 37 leagues, when he was sure of his latitude within two minutes. The volcano was seen at 4° S. E., so that the error in longitude must have an almost imperceptible influence in the estimation of the distance. Nevertheless, the angle which the peak of the Azores subtended was so great, that the captain of the Pizarro was of opinion this volcano must be visible at more than 40 or 42 leagues. The distance of 37 leagues supposes an elevation of 1,431 toises.

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of attention because vessels returning to Europe, sometimes wait impatiently for a sight of these mountains, to rectify their longitude; and think themselves much farther off than they really are, when in fine weather these peaks are not perceptible at distances where the angles subtended must be very considerable. The constitution of the atmosphere has a great influence on the visibility of distant objects. It may be admitted, that in general the peak of Teneriffe is seldom seen at a great distance, in the warm and dry months of July and August; and that, on the contrary, it is seen at very extraordinary distances in the months of January and February, when the sky is slightly clouded, and immediately after a heavy rain, or a few hours before it falls. It appears that the transparency of the air is prodigiously increased, as we have already observed, when a certain quantity of water is uniformly diffused through the atmosphere. Independent of these observations, it is not astonishing, that the peak of Teyde should be seldomer visible at a very remote distance, than the summits of the Andes, to which, during so long a time, my observations were directed. This peak, inferior in height to those parts of the chain of Mount Atlas at the foot of which is the city of Morocco, is not, like those points, covered with perpetual snows. The Piton, or Sugar-loaf, which terminates the peak, no doubt reflects a great quantity of light, owing to the whitish colour of the pumice-stone thrown up by the crater; but the height of that little truncated cone does not form a twenty-second part of the total elevation. The flanks of the volcano are covered either with blocks of black and scorified lava, or with a luxuriant vegetation, the masses of which reflect the less light, as the leaves of the trees are separated from each other by shadows of more considerable extent than that of the part enlightened.

Hence it results that, setting aside the Piton, the peak of Teyde belongs to that class of mountains, which, according to the expression of Bouger, are seen at considerable distances only in a *negative manner*, because they intercept the light which is transmitted to us from the extreme limits of the atmosphere; and we perceive their existence only on account of the difference of intensity subsisting between the aerial light which surrounds them, and that which is reflected

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by the particles of air placed between the mountains and the eye of the observer. As we withdraw from the isle of Teneriffe, the Piton or Sugar-loaf is seen for a considerable space of time in a *positive manner*, because it reflects a whitish light, and clearly detaches itself from the sky. But as this cone is only 80 toises high, by 40 in breadth at its summit, it has recently been a question whether, from the diminutiveness of its mass, it can be visible at distances which exceed 40 leagues; and whether it be not probable, that navigators distinguish the peaks as a small cloud above the horizon, only when the base of the Piton begins to be visible on it. If we admit, that the mean breadth of the Sugar-loaf is 100 toises, we find that the little cone, at 40 leagues distance, still subtends, in the horizontal direction, an angle of more than three minutes. This angle is considerable enough to render an object visible; and if the height of the Piton greatly exceeded its base, the angle in the horizontal direction might be still smaller, and the object still continue to make an impression on our visual organs; for micrometrical observations have proved that the limit of vision is but a minute only, when the dimensions of the objects are the same in every direction. We distinguish at a distance, by the eye only, trunks of trees insulated in a vast plain, though the subtended angle be under twenty-five seconds.

As the visibility of an object detaching itself in a brown colour, depends on the quantities of light which the eye meets on two lines, one of which ends at the mountain, and the other extends to the surface of the aerial ocean, it follows that the farther we remove from the object, the smaller the difference becomes between the light of the surrounding atmosphere, and that of the strata of air before the mountain. For this reason, when less elevated summits begin to appear above the horizon, they present themselves at first under a darker hue than those we discern at very great distances. In the same manner, the visibility of mountains seen only in a negative manner, does not depend solely on the state of the lower regions of the air, to which our meteorological observations are limited, but also on the transparency and physical constitution of the air in the most elevated parts; for the image detaches itself better in proportion as the aërial light, which comes from the limits of the atmosphere, has been

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originally more intense, or has undergone less loss in its passage. This consideration explains to a certain point, why, under a perfectly serene sky, the state of the thermometer and the hygrometer being precisely the same in the air nearest the earth, the peak is sometimes visible, and at other times invisible, to navigators at equal distances. It is even probable, that the chance of perceiving this volcano would not be greater, if the ashy cone, at the summit of which is the mouth of the crater, were equal, as in Vesuvius, to a quarter of the total height. These ashes, being pumice-stone crumbled into dust, do not reflect as much light as the snow of the Andes; and they cause the mountain, seen from afar, to detach itself not in a bright, but in a dark hue. The ashes also contribute, if we may use the expression, to equalize the portions of aërial light, the variable difference of which renders the object more or less distinctly visible. Calcareous mountains, devoid of vegetable earth, summits covered with granitic sand, the high savannahs of the Cordilleras,* which are of a golden yellow, are undoubtedly distinguished at small distances better than objects which are seen in a negative manner; but the theory indicates a certain limit, beyond which these last detach themselves more distinctly from the azure vault of the sky.

The colossal summits of Quito and Peru, towering above the limit of the perpetual snows, concentre all the peculiarities which must render them visible at very small angles. The circular summit of the peak of Teneriffe is only a hundred toises in diameter. According to the measures I made at Riobamba, in 1803, the dome of the Chimborazo, 153 toises below its summit, consequently in a point which is 1300 toises higher than the peak, is still 673 toises (1312 metres) in breadth. The zone of perpetual snows also forms a fourth of the height of the mountain; and the base of this zone, seen on the coast of the Pacific, fills an extent of 3437 toises (6700 metres). But though Chimborazo is two-thirds higher than the peak, we do not see it, on account of the curve of the globe, at more than 38 miles and a third farther distant. The radiant brilliancy of its snows, when, at the port of Guayaquil, at the close of the rainy season, Chimbo-

* *Los Pajonales*, from *paja*, straw. This is the name given to the region of the gramina, which encircles the zone of the perpetual snows.

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razo is discerned on the horizon, may lead us to suppose, that it must be seen at a very great distance in the South Sea. Pilots highly worthy of credit have assured me, that they have seen it from the rock of Muerto, to the south west of the isle of Puna, at a distance of 47 leagues. Whenever it has been seen at a greater distance, the observers, uncertain of their longitude, have not been in a situation to furnish precise data.

Aërial light, projected on mountains, increases the visibility of those which are seen positively; its power diminishes, on the contrary, the visibility of objects which, like the peak of Teneriffe and that of the Azores, detach themselves in a brown tint. Bouguer, relying on theoretical considerations, was of opinion that, according to the constitution of our atmosphere, mountains seen negatively cannot be perceived at distances exceeding 35 leagues. It is important here to observe, that these calculations are contrary to experience. The peak of Teneriffe has been often seen at the distance of 36, 38, and even at 40 leagues. Moreover, in the vicinity of the Sandwich Islands, the summit of Mowna-Roa, at a season when it was without snows, has been seen on the skirt of the horizon, at the distance of 53 leagues. This is the most striking example we have hitherto known of the visibility of a mountain; and it is the more remarkable, that an object seen negatively furnishes this example.

The volcanoes of Teneriffe, and of the Azores, the Sierra Nevada of St. Martha, the peak of Orizaba, the Silla of Caracas, Mowna-Roa, and Mount St. Elias, insulated in the vast extent of the seas, or placed on the coasts of continents, serve as sea-marks to direct the pilot, when he has no means of determining the position of the vessel by the observation of the stars; everything which has a relation to the visibility of these natural seamarks, is interesting to the safety of navigation.

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Chapter II.

Stay at Teneriffe.—Journey from Santa Cruz to Orotava.—Excursion to the summit of the Peak of Teyde.

From the time of our departure from Graciosa, the horizon continued so hazy, that, notwithstanding the considerable height of the mountains of Canary,* we did not discover that island till the evening of the 18th of June. It is the granary of the archipelago of the Fortunate Islands; and, what is very remarkable in a region situated beyond the limits of the tropics, we were assured, that in some districts, there are two wheat harvests in the year; one in February, and the other in June. Canary has never been visited by a learned mineralogist; yet this island is so much the more worthy of observation, as the physiognomy of its mountains, disposed in parallel chains, appeared to me to differ entirely from that of the summits of Lancerota and Teneriffe. Nothing is more interesting to the geologist, than to observe the relations, on the same point of the globe, between volcanic countries, and those which are primitive or secondary. When the Canary Islands shall have been examined, in all the parts which compose the system of these mountains, we shall find that we have been too precipitate in considering the whole group as raised by the action of submarine fires.

On the morning of the 19th, we discovered the point of Naga, but the peak of Teneriffe was still invisible: the land, obscured by a thick mist, presented forms that were vague and confused. As we approached the road of Santa Cruz, we observed that the mist, driven by the winds, drew nearer to us. The sea was strongly agitated, as it most commonly is in those latitudes. We anchored after several soundings, for the mist was so thick, that we could scarcely distinguish objects at a few cables' distance; but at the moment we began to salute the place, the fog was instantly dispelled. The peak of Teyde appeared in a break above the clouds, and the first rays of the sun, which had not yet risen on us, illumined the summit of the volcano.

We hastened to the prow of the vessel to behold the mag-

* Isla de la Gran Canaria.

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nificent spectacle, and at the same instant we saw four English vessels lying to, and very near our stern. We had passed without being perceived, and the same mist which had concealed the peak from our view, had saved us from the risk of being carried back to Europe. The Pizarro stood in as close as possible to the fort, to be under its protection. It was on this shore, that, in the landing attempted by the English two years before our arrival, in July 1797, admiral Nelson had his arm carried off by a cannon-ball.

The situation of the town of Santa Cruz is very similar to that of La Guayra, the most frequented port of the province of Caraccas. The heat is excessive in both places, and from the same causes; but the aspect of Santa Cruz is more gloomy. On a narrow and sandy beach, houses of dazzling whiteness, with flat roofs, and windows without glass, are built close against a wall of black perpendicular rock, devoid of vegetation. A fine mole, built of freestone, and the public walk planted with poplars, are the only objects which break the sameness of the landscape. The view of the peak, as it presents itself above Santa Cruz, is much less picturesque than that we enjoy from the port of Orotava. There, a highly cultured and smiling plain presents a pleasing contrast to the wild aspect of the volcano. From the groups of palm trees and bananas which line the coast, to the region of the arbutus, the laurel, and the pine, the volcanic rock is crowned with luxuriant vegetation. We easily conceive how the inhabitants, even of the beautiful climates of Greece and Italy, might fancy they recognised one of the Fortunate Isles in the western part of Teneriffe. The eastern side, that of Santa Cruz, on the contrary, is every where stamped with sterility. The summit of the peak is not more arid than the promontory of basaltic lava, which stretches towards the point of Naga, and on which succulent plants, springing up in the clefts of the rocks, scarcely indicate a preparation of soil. At the port of Orotava, the top of the Piton subtends an angle in height of more than eleven degrees and a half; while at the mole of Santa Cruz* the angle scarcely exceeds 4° 36′.

Notwithstanding this difference, and though in the latter

* The oblique distances from the top of the volcano to Orotava and to Santa Cruz are nearly 8,600 toises and 22,500 toises.

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place the volcano rises above the horizon scarcely as much as Vesuvius seen from the mole of Naples, the aspect of the peak is still very majestic, when those who anchor in the road discern it for the first time. The Piton alone was visible to us; its cone projected itself on a sky of the purest blue, whilst dark thick clouds enveloped the rest of the mountain to the height of 1800 toises. The pumice-stone, illumined by the first rays of the sun, reflected a reddish light, like that which tinges the summits of the higher Alps, This light by degrees becomes dazzlingly white; and, deceived like most travellers, we thought that the peak was still covered with snow, and that we should with difficulty reach the edge of the crater.

We have remarked, in the Cordillera of the Andes, that the conical mountains, such as Cotopaxi and Tungurahua, are oftener seen free from clouds, than those of which the tops are broken into bristly points, like Antisana and Pichincha; but the peak of Teneriffe, notwithstanding its pyramidical form, is a great part of the year enveloped in vapours, and is sometimes, during several weeks, invisible from the road of Santa Cruz. Its position to the west of an immense continent, and its insulated situation in the midst of the sea, are no doubt the causes of this phenomenon. Navigators are well aware that even the smallest islets, and those which are without mountains, collect and harbour the clouds. The decrement of heat is also different above the plains of Africa, and above the surface of the Atlantic; and the strata of air, brought by the trade winds, cool in proportion as they advance towards the west. If the air has been extremely dry above the burning sands of the desert, it is very quickly saturated when it enters into contact with the surface of the sea, or with the air that lies on that surface. It is easy to conceive, therefore, why vapours become visible in the atmospherical strata, which, at a distance from the continent, have no longer the same temperature as when they began to be saturated with water. The considerable mass of a mountain, rising in the midst of the Atlantic, is also an obstacle to the clouds, which are driven out to sea by the winds.

On entering the streets of Santa Cruz, we felt a suffocating heat, though the thermometer was not above twenty-

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five degrees. Those who have for a long time inhaled the air of the sea suffer every time they land; not because this air contains more oxygen than the air on shore, as has been erroneously supposed, but because it is less charged with those gaseous combinations, which the animal and vegetable substances, and the mud resulting from their decomposition, pour into the atmosphere. Miasms that escape chemical analysis have a powerful effect on our organs, especially when they have not for a long while been exposed to the same kind of irritation.

Santa Cruz, the Añaza of the Guanches, is a neat town, with a population of 8000 souls. I was not struck with the vast number of monks and secular ecclesiastics, which travellers have thought themselves bound to find in every country under the Spanish government; nor shall I stop to enter into the description of the churches; the library of the Dominicans, which contains scarcely a few hundred volumes; the mole, where the inhabitants assemble to inhale the freshness of the evening breeze; or the famed monument of Carrara marble, thirty feet high, dedicated to *Our Lady of Candelaria*, in memory of the miraculous appearance of the Virgin, in 1392, at Chimisay, near Guimar. The port of Santa Cruz may be considered as a great caravanserai, on the road to America and the Indies. Every traveller who writes the narrative of his adventures, begins by a description of Madeira and Teneriffe; and if in the natural history of these islands there yet remains an immense field untrodden, we must admit that the topography of the little towns of Funchal, Santa Cruz, Laguna, and Orotava, leaves scarcely anything untold.

The recommendation of the court of Madrid procured for us, in the Canaries, as in all the other Spanish possessions, the most satisfactory reception. The captain-general gave us immediate permission to examine the island. Col. Armiaga, who commanded a regiment of infantry, received us into his house with kind hospitality. We could not cease admiring the banana, the papaw tree, the Poinciana pulcherrima, and other plants, which we had hitherto seen only in hot-houses, cultivated in his garden in the open air. The climate of the Canaries however is not warm enough to ripen the real *Platano Arton*, with triangular fruit from seven to eight

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inches long, and which, requiring a temperature of 24 centesimal degrees, does not flourish even in the valley of Caracas. The bananas of Teneriffe are those named by the Spanish planters *Camburis* or *Guineos*, and *Dominicos*. The Camburi, which suffers least from cold, is cultivated with success even at Malaga, where the temperature is only 18 degrees; but the fruit we see occasionally at Cadiz comes from the Canary Islands by vessels which make the passage in three or four days. In general, the musa, known by every people under the torrid zone, though hitherto never found in a wild state, has as great a variety of fruit as our apple and pear trees. These varieties, which are confounded by the greater part of botanists, though they require very different climates, have become permanent by long cultivation.

We went to herborize in the evening in the direction of the fort of Passo Alto, along the basaltic rocks that close the promontory of Naga. We were very little satisfied with our harvest, for the drought and dust had almost destroyed vegetation. The Cacalia Kleinia, the Euphorbia canariensis, and several other succulent plants, which draw their nourishment from the air rather than the soil on which they grow, reminded us by their appearance, that this group of islands belongs to Africa, and even to the most arid part of that continent.

Though the captain of the Pizarro had orders to stop long enough at Teneriffe to give us time to scale the summit of the peak, if the snows did not prevent our ascent, we received notice, on account of the blockade of the English ships, not to expect a longer delay than four or five days. We consequently hastened our departure for the port of Orotava, which is situated on the western declivity of the volcano, where we were sure of finding guides. I could find no one at Santa Cruz who had mounted the peak, and I was not surprised at this. The most curious objects become less interesting, in proportion as they are near to us; and I have known inhabitants of Schaffhausen, in Switzerland, who had never seen the fall of the Rhine but at a distance.

On the 20th of June, before sunrise, we began our excursion by ascending to the Villa de Laguna, estimated to be at the elevation of 350 toises above the port of Santa Cruz.

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We could not verify this estimate of the height, the surf not having permitted us to return on board during the night, to take our barometers and dipping-needle. As we foresaw that our expedition to the peak would be very precipitate, we consoled ourselves with the reflection that it was well not to expose instruments which were to serve us in countries less known by Europeans. The road by which we ascended to Laguna is on the right of a torrent, or *baranco*, which in the rainy season forms fine cascades; it is narrow and tortuous. Near the town we met some white camels, which seemed to be very slightly laden. The chief employment of these animals is to transport merchandise from the custom-house to the warehouses of the merchants. They are generally laden with two chests of Havannah sugar, which together weigh 900 pounds; but this load may be augmented to thirteen hundred-weight, or 52 arrobas of Castile. Camels are not numerous at Teneriffe, whilst they exist by thousands in the two islands of Lancerota and Forteventura; the climate and vegetation of these islands, which are situated nearer Africa, are more analogous to those of that continent. It is very extraordinary, that this useful animal, which breeds in South America, should be seldom propagated at Teneriffe. In the fertile district of Adexe only, where the plantations of the sugar-cane are most considerable, camels have sometimes been known to breed. These beasts of burden, as well as horses, were brought into the Canary Islands in the fifteenth century by the Norman conquerors. The Guanches were previously unacquainted with them; and this fact seems to be very well accounted for by the difficulty of transporting an animal of such bulk in frail canoes, without the necessity of considering the Guanches as a remnant of the people of Atlantis, or a different race from that of the western Africans.

The hill, on which the town of San Christobal de la Laguna is built, belongs to the system of basaltic mountains, which, independent of the system of less ancient volcanic rocks, form a broad girdle around the peak of Teneriffe. The basalt on which we walked was darkish brown, compact, half-decomposed, and when breathed on, emitted a clayey smell. We discovered amphibole, olivine,* and translucid pyrox-

* Peridot granuliforme. Hauy.

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enes,* with a perfectly lamellar fracture, of a pale olive green, and often crystallized in prisms of six planes. The first of these substances is extremely rare at Teneriffe; and I never found it in the lavas of Vesuvius; but those of Etna contain it in abundance. Notwithstanding the great number of blocks, which we stopped to break, to the great regret of our guides, we could discover neither nepheline, leucite,† nor feldspar. This last, which is so common in the basaltic lavas of the island of Ischia, does not begin to appear at Teneriffe, till we approach the volcano. The rock of Laguna is not columnar, but is divided into ledges, of small thickness, and inclined to the east at an angle of 30 or 40 degrees. It has nowhere the appearance of a current of lava flowing from the sides of the peak. If the present volcano has given birth to these basalts, we must suppose, that, like the substances which compose the Somma, at the back of Vesuvius, they are the effect of a submarine effusion, in which the liquid mass has formed strata. A few arborescent Euphorbias, the Cacalia Kleinia, and Indian figs (Cactus), which have become wild in the Canary Islands, as well as in the south of Europe and the whole continent of Africa, are the only plants we see on these arid rocks. The feet of our mules were slipping every moment on beds of stone, which were very steep. We nevertheless recognized the remains of an ancient pavement. In these colonies we discover at every step some traces of that activity which characterized the Spanish nation in the 16th century.

As we approached Laguna, we felt the temperature of the atmosphere gradually become lower. This sensation was so much the more agreeable, as we found the air of Santa Cruz very oppressive. As our organs are more affected by disagreeable impressions, the change of temperature becomes still more sensible when we return from Laguna to the port: we seem then to be drawing near the mouth of a furnace. The same impression is felt, when, on the coast of Caracas, we descend from the mountain of Avila to the port of La Guayra. According to the law of the decrement of heat, three hundred and fifty toises in height produce in this latitude only three or four degrees difference in temperature.

* Augite.—Werner. † Amphigène.—Hauy.

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The heat which overpowers the traveller on his entrance into Santa Cruz, or La Guayra, must consequently be attributed to the reverberation from the rocks, against which these towns are built.

The perpetual coolness which prevails at Laguna causes it to be considered in the Canaries a delightful abode. Situated in a small plain, surrounded by gardens, protected by a hill which is crowned by a wood of laurels, myrtle, and arbutus, the capital of Teneriffe is very beautifully placed. We should be mistaken if, relying on the account of some travellers, we believed it seated on the border of a lake. The rain sometimes forms a sheet of water of considerable extent; and the geologist, who beholds in everything the past rather than the present state of nature, can have no doubt but that the whole plain is a great basin dried up. Laguna has fallen from its opulence, since the lateral eruptions of the volcano have destroyed the port of Garachico, and since Santa Cruz has become the central point of the commerce of the island. It contains only 9000 inhabitants, of whom nearly 400 are monks, distributed in six convents. The town is surrounded with a great number of windmills, which indicate the cultivation of wheat in these high countries. I shall observe on this occasion, that different kinds of grain were known to the Guanches. They called wheat at Teneriffe *tano*, at Lancerota *triffa;* barley, in the grand Canary, bore the name of *aramotanoque*, and at Lancerota it was called *tamosen*. The flour of roasted barley (*gofio*) and goat's-milk constituted the principal food of the people, on the origin of which so many systematic fables have been current. These aliments sufficiently prove that the race of the Guanches belonged to the nations of the old continent, perhaps to those of Caucasus, and not like the rest of the Atlantides,* to the inhabitants of the New World; these, before the arrival of the Europeans, were unacquainted with corn, milk, and cheese.

A great number of chapels, which the Spaniards call *ermi-*

* Without entering here into any discussion respecting the existence of the Atlantis, I may cite the opinion of Diodorus Siculus, according to whom the Atlantides were ignorant of the use of corn, because they were separated from the rest of mankind before these gramina were cultivated.

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tas, encircle the town of Laguna. Shaded by trees of perpetual verdure, and erected on small eminences, these chapels add to the picturesque effect of the landscape. The interior of the town is not equal to its external appearance. The houses are solidly built, but very antique, and the streets seem deserted. A botanist ought not to complain of the antiquity of the edifices. The roofs and walls are covered with Canary house-leek and those elegant trichomanes, mentioned by every traveller. These plants are nourished by the abundant mists.

Mr. Anderson, the naturalist in the third voyage of captain Cook, advises physicians to send their patients to Teneriffe, on account of the mildness of the temperature and the equal climate of the Canaries. The ground on these islands rises in an amphitheatre, and presents simultaneously, as in Peru and Mexico, the temperature of every climate, from the heat of Africa to the cold of the higher Alps. Santa Cruz, the port of Orotava, the town of the same name, and that of Laguna, are four places, the mean temperatures of which form a descending series. In the south of Europe the change of the seasons is too sensibly felt to present the same advantages. Teneriffe, on the contrary, situated as it were on the threshold of the tropics, though but a few days' sail from Spain, shares in the charms which nature has lavished on the equinoctial regions. Vegetation here displays some of her fairest and most majestic forms in the banana and the palm-tree. He who is alive to the charms of nature finds in this delicious island remedies still more potent than the climate. No abode appeared to me more fitted to dissipate melancholy, and restore peace to the perturbed mind, than that of Teneriffe or Madeira. These advantages are the effect not of the beauty of the site and the purity of the air alone: the moral feeling is no longer harrowed up by the sight of slavery, the presence of which is so revolting in the West Indies, and in every other place to which European colonists have conveyed what they call their civilization and their industry.

In winter the climate of Laguna is extremely foggy, and the inhabitants often complain of the cold. A fall of snow, however, has never been seen; a fact which may seem to indicate

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that the mean temperature of this town must be above 18·7° (15° R.), that is to say, higher than that of Naples. I do not lay this down as an unexceptional conclusion, for in winter the refrigeration of the clouds does not depend so much on the mean temperature of the whole year, as on the instantaneous diminution of heat to which a district is exposed by its local situation. The mean temperature of the capital of Mexico, for instance, is only 16·8° (13·5° R.), nevertheless, in the space of a hundred years snow has fallen only once, while in the south of Europe and in Africa it snows in places where the mean temperature is above 19 degrees.

The vicinity of the sea renders the climate of Laguna more mild in winter than might be expected, arising from its elevation above the level of the ocean. I was astonished to learn that M. Broussonnet had planted in the midst of this town, in the garden of the Marquis de Nava, the bread-fruit tree (Artocarpus incisa), and cinnamon-tree (Laurus Cinnamomum). These valuable productions of the South Sea and the East Indies are naturalized there as well as at Orotava. Does not this fact prove that the bread-fruit might flourish in Calabria, Sicily, and Granada? The culture of the coffee-tree has not equally succeeded at Laguna, though its fruit ripens at Teguesta, as well as between the port of Orotava and the village of St. Juan de la Rambla. It is probable that some local circumstances, perhaps the nature of the soil and the winds that prevail in the flowering season, are the cause of this phenomenon. In other regions, in the neighbourhood of Naples, for instance, the coffee-tree thrives abundantly, though the mean temperature scarcely rises above 18 centigrade degrees.

No person has ascertained in the island of Teneriffe, the lowest height at which snow falls every year. This fact, though easy of verification by barometrical measurements, has hitherto been generally neglected under every zone. It is nevertheless highly interesting both to agriculture in the colonies and meteorology, and fully as important as the measure of the limit of the perpetual snows. My observations furnished me with the data, set down in the following table:—

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North latitude.	Lowest height at which snow falls.		Inferior limit of the perpetual snows.		Difference of the two preceding columns.		Mean temperature.	
	Toises.	Metres.	Toises.	Metres.	Toises.	Metres.	Cent.	Reaum.
0°	2040	3976	2460	4794	420	818	27°	21·6°
20°	1550	3020	2360	4598	810	1578	24·5°	19·6°
40°	0	0	1540	3001	1540	3001	17°	13·6°

This table presents only the ordinary state of nature, that is to say, the phenomena as they are annually observed. Exceptions founded on particular local circumstances, exist. Thus it sometimes snows, though seldom, at Naples, at Lisbon, and even at Malaga, consequently as low as the 37th degree of latitude: and, as we have just observed, snow has been seen to fall at Mexico, the elevation of which is 1173 toises above the level of the ocean. This phenomenon, which had not been seen for several centuries, took place on the day that the Jesuits were expelled, and was attributed by the people to that act of severity. A more striking exception was found in the climate of Valladolid, the capital of the province of Mechoacan. According to my measures, the height of this town, situate in latitude 19° 42′, is only a thousand toises: and yet, a few years before our arrival in New Spain, the streets were covered with snow for some hours.

Snow had been seen to fall also at Teneriffe, in a place lying above Esperanza de la Laguna, very near the town of that name, in the gardens of which the artocarpus flourishes. This extraordinary fact was confirmed to M. Broussonnet by very aged persons. The Erica arborea, the Myrica Faya, and the Arbutus callicarpa,* did not suffer from the snow; but it destroyed all the vines in the open air. This observation is interesting to vegetable physiology. In hot countries, the plants are so vigorous, that cold is less injurious to them,

* This fine arbutus, imported by M. Broussonnet, is very different from the Arbutus laurifolia, with which it has been confounded, but which belongs to North America.

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provided it be of short duration. I have seen the banana cultivated in the island of Cuba, in places where the thermometer descends to seven centesimal degrees, and sometimes very near freezing point. In Italy and Spain the orange and date-trees do not perish, though the cold during the night may be two degrees below freezing point. In general it is remarked by cultivators, that the trees which grow in a fertile soil are less delicate, and consequently less affected by great changes in the temperature, than those which grow in land that affords but little nutriment.*

In order to pass from the town of Laguna to the port of Orotava and the western coast of Teneriffe, we cross at first a hilly region covered with black and argillaceous earth, in which are found some small crystals of pyroxene. The waters most probably detach these crystals from the neighbouring rocks, as at Frascati, near Rome. Unfortunately, strata of ferruginous earth conceal the soil from the researches of the geologist. It is only in some ravines, that we find columnar basalts, somewhat curved, and above them very recent breccia, resembling volcanic tufa. The breccia contain fragments of the same basalts which they cover; and it is asserted that marine petrifactions are observed in them. The same phenomenon occurs in the Vicentin, near Montechio Maggiore.

The valley of Tacoronte is the entrance into that charming country, of which travellers of every nation have spoken with rapturous enthusiasm. Under the torrid zone I found sites where nature is more majestic, and richer in the display of organic forms; but after having traversed the banks of the Orinoco, the Cordilleras of Peru, and the most beautiful valleys of Mexico, I own that I have never beheld a prospect more varied, more attractive, more harmonious in the distribution of the masses of verdure and of rocks, than the western coast of Teneriffe.

* The mulberries, cultivated in the thin and sandy soils of countries bordering on the Baltic Sea, are examples of this feebleness of organization. The late frosts do more injury to them, than to the mulberries of Piedmont. In Italy a cold of 5° below freezing point does not destroy robust orange trees. According to M. Galesio, these trees, less tender than the lemon and bergamot orange trees, freeze only at ten centesimal degrees below freezing point.

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The sea-coast is lined with date and cocoa trees. Groups of the musa, as the country rises, form a pleasing contrast with the dragon-tree, the trunks of which have been justly compared to the tortuous form of the serpent. The declivities are covered with vines, which throw their branches over towering poles. Orange trees loaded with flowers, myrtles, and cypress trees encircle the chapels reared to devotion on the isolated hills. The divisions of landed property are marked by hedges formed of the agave and the cactus. An innumerable quantity of cryptogamous plants, among which ferns are the most predominant, cover the walls, and are moistened by small springs of limpid water. In winter, when the volcano is buried under ice and snow, this district enjoys perpetual spring. In summer, as the day declines, the breezes from the sea diffuse a delicious freshness. The population of this coast is very considerable; and it appears to be still greater than it is, because the houses and gardens are distant from each other, which adds to the picturesque beauty of the scene. Unhappily the real welfare of the inhabitants does not correspond with the exertions of their industry, or with the advantages which nature has lavished on this spot. The farmers are not land-owners; the fruits of their labour belong to the nobles; and those feudal institutions, which, for so long a time, spread misery throughout Europe, still press heavily on the people of the Canary Islands.

From Tegueste and Tacoronte to the village of St. Juan de la Rambla (which is celebrated for its excellent malmsey wine), the rising hills are cultivated like a garden. I might compare them to the environs of Capua and Valentia, if the western part of Teneriffe was not infinitely more beautiful on account of the proximity of the peak, which presents on every side a new point of view. The aspect of this mountain is interesting not merely from its gigantic mass; it excites the mind, by carrying it back to the mysterious source of its volcanic agency. For thousands of years, no flames or light have been perceived on the summit of the Piton, nevertheless enormous lateral eruptions, the last of which took place in 1798, are proofs of the activity of a fire still far from being extinguished. There is also something that leaves a melancholy impression on beholding a crater in the centre

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of a fertile and well cultivated country. The history of the globe informs us, that volcanoes destroy what they have been a long series of ages in creating. Islands, which the action of submarine fires has raised above the waters, are by degrees clothed in rich and smiling verdure; but these new lands are often laid waste by the renewed action of the same power which caused them to emerge from the bottom of the ocean. Islets, which are now but heaps of scoriæ and volcanic ashes, were once perhaps as fertile as the hills of Tacoronte and Sauzal. Happy the country, where man has no distrust of the soil on which he lives!

Pursuing our course to the port of Orotava, we passed the smiling hamlets of Matanza and Victoria. These names are mingled together in all the Spanish colonies, and they form an unpleasing contrast with the peaceful and tranquil feelings which those countries inspire. *Matanza* signifies slaughter, or carnage; and the word alone recalls the price at which victory has been purchased. In the New World it generally indicates the defeat of the natives: at Teneriffe, the village of Matanza was built in a place* where the Spaniards were conquered by those same Guanches who soon after were sold as slaves in the markets of Europe.

Before we reached Orotava, we visited a botanic garden at a little distance from the port. We there found M. Le Gros, the French vice-consul, who had often scaled the summit of the Peak, and who served us as an excellent guide. He was accompanying captain Baudin in a voyage to the West Indies, when a dreadful tempest, of which M. Le Dru has given an account in the narrative of his voyage to Porto Rico, forced the vessel to put into Teneriffe. There M. Le Gros was led by the beauty of the spot to settle. It was he who augmented scientific knowledge by the first accurate ideas of the great lateral eruption of the Peak, which has been very improperly called the explosion of the volcano of Chahorra. This eruption took place on the 8th of June, 1798.

The establishment of a botanical garden at Teneriffe is a very happy idea, on account of the influence it is likely to have on the progress of botany, and on the introduction of useful plants into Europe. For the first conception of

* The ancient Acantejo.

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it we are indebted to the Marquis de Nava. He undertook, at an enormous expense, to level the hill of Durasno, which rises as an amphitheatre, and which was begun to be planted in 1795. The marquis thought that the Canary Islands, from the mildness of their climate and geographical position, were the most suitable place for naturalising the productions of the East and West Indies, and for inuring the plants gradually to the colder temperature of the south of Europe. The plants of Asia, Africa, and South America, may easily be brought to Orotava; and in order to introduce the bark-tree* into Sicily, Portugal, or Grenada, it should be first planted at Durasno, or at Laguna, and the shoots of this tree may afterwards be transported into Europe from the Canaries. In happier times, when maritime wars shall no longer interrupt communication, the garden of Teneriffe may become extremely useful with respect to the great number of plants which are sent from the Indies to Europe; for ere they reach our coasts, they often perish, owing to the length of the passage, during which they inhale an air impregnated with salt water. These plants would meet at Orotava with the care and climate necessary for their preservation. At Durasno, the protea, the psidium, the jambos, the chirimoya of Peru,† the sensitive plant, and the heliconia, grow in the open air. We gathered the ripened seeds of several beautiful species of glycine from New Holland, which the governor of Cumana, Mr. Emparan, had successfully cultivated, and which grow wild on the coasts of South America.

We arrived very late at the port of Orotava,‡ if we may give the name of port to a road in which vessels are obliged to put to sea whenever the winds blow violently from the north-west. It is impossible to speak of Orotava

* I speak of the species of bark-tree (cinchona), which at Peru, and in the kingdom of New Granada, flourish on the back of the Cordilleras, at the height of between 1,000 and 1,500 toises, in places where the thermometer is between nine and ten degrees during the day, and from three to four during the night. The orange bark-tree (Cinchona lancifolia) is much less delicate than the red bark-tree (C. oblongifolia).

† Annona cherimolia. Lamarck.

‡ Puerto de la Cruz. The only fine port of the Canary Islands is that of St. Sebastian, in the isle of Gomara.

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without recalling to the remembrance of the friends of science the name of Don Bernardo Cologan, whose house at all times was open to travellers of every nation.

We could have wished to have sojourned for some time in Don Bernardo's house, and to have visited with him the charming scenery of St. Juan de la Rambla and of Rialexo de Abaxo.* But on a voyage such as we had undertaken, the present is but little enjoyed. Continually haunted by the fear of not executing the designs of the morrow, we live in perpetual uneasiness. Persons who are passionately fond of nature and the arts feel the same sensations, when they travel through Switzerland and Italy. Enabled to see but a small portion of the objects which allure them, they are disturbed in their enjoyments by the restraints they impose on themselves at every step.

On the morning of the 21st of June, we were on our way to the summit of the volcano. M. le Gros, whose attentions were unwearied, M. Lalande, secretary to the French Consulate at Santa Cruz, and the English gardener at Durasno, joined us on this excursion. The day was not very fine, and the summit of the peak, which is generally visible at Orotava from sunrise till ten o'clock, was covered with thick clouds.

We were agreeably surprised by the contrast between the vegetation of this part of Teneriffe, and that of the environs of Santa Cruz. Under the influence of a cool and humid climate, the ground was covered with beautiful verdure; while on the road from Santa Cruz to Laguna the plants exhibited nothing but capsules emptied of their seeds. Near the port of Santa Cruz, the strength of the vegetation is an obstacle to geological research. We passed along the base of two small hills, which rise in the form of bells. Observations made at Vesuvius and in Auvergne lead us to think that these hills owe their origin to lateral eruptions of the great volcano. The hill called *Montañita de la Villa* seems indeed to have emitted lavas; and according to the tradition of the Guanches, an eruption took place in 1430. Colonel Franqui assured Borda, that the place is still to be seen whence the melted matter

* This last-named village stands at the foot of the lofty mountain of Tygayga.

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issued; and that the ashes which covered the ground adjacent, were not yet fertilized. Whenever the rock appeared, we discovered basaltic amygdaloid* covered with hardened clay,† which contains *rapilli*, or fragments of pumice-stone. This last formation resembles the tufas of Pausilippo, and the strata of puzzolana, which I found in the valley of Quito, at the foot of the volcano of Pichincha. The amygdaloid has very long pores, like the superior strata of the lavas of Vesuvius, arising probably from the action of an elastic fluid forcing its way through the matter in fusion. Notwithstanding these analogies, I must here repeat, that in all the low region of the peak of Teneriffe, on the side of Orotava, I have met with no flow of lava, nor any current, the limits of which are strongly marked. Torrents and inundations change the surface of the globe, and when a great number of currents of lava meet and spread over a plain, as I have seen at Vesuvius, in the Atrio dei Cavalli, they seem to be confounded together, and wear the appearance of real strata.

The villa de Orotava has a pleasant aspect at a distance, from the great abundance of water which runs through the principal streets. The spring of Agua Mansa, collected in two large reservoirs, turns several mills, and is afterward discharged among the vineyards of the adjacent hills. The climate is still more refreshing at the villa than at the port of La Cruz, from the influence of the breeze, which blows strong after ten in the morning. The water, which has been dissolved in the air at a higher temperature, frequently precipitates itself, and renders the climate very foggy. The villa is nearly 160 toises (312 metres) above the level of the sea, consequently 200 toises lower than the site on which Laguna is built: it is observed also, that the same kind of plants flower a month later in this latter place.

Orotava, the ancient Taoro of the Guanches, is situated on a very steep declivity. The streets seem deserted; the houses are solidly built, and of a gloomy appearance. We passed along a lofty aqueduct, lined with a great number of fine ferns; and visited several gardens, in which the fruit trees of the north of Europe are mingled with orange trees,

* Basaltartiger Mandelstein. Werner.
† Bimstein-Conglomerat. W.

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pomegranate, and date trees. We were assured, that these last were as little productive here as on the coast of Cumana. Although we had been made acquainted, from the narratives of many travellers, with the dragon-tree of the garden of M. Franqui, we were not the less struck with its enormous magnitude. We were told, that the trunk of this tree, which is mentioned in several very ancient documents as marking the boundaries of a field, was as gigantic in the fifteenth century as it is at the present time. Its height appeared to us to be about 50 or 60 feet; its circumference near the roots is 45 feet. We could not measure higher, but Sir George Staunton found that, 10 feet from the ground, the diameter of the trunk is still 12 English feet; which corresponds perfectly with the statement of Borda, who found its mean circumference 33 feet 8 inches, French measure. The trunk is divided into a great number of branches, which rise in the form of a candelabrum, and are terminated by tufts of leaves, like the yucca which adorns the valley of Mexico. This division gives it a very different appearance from that of the palm-tree.

Among organic creations, this tree is undoubtedly, together with the Adansonia or baobab of Senegal, one of the oldest inhabitants of our globe. The baobabs are of still greater dimensions than the dragon-tree of Orotava. There are some which near the root measure 34 feet in diameter, though their total height is only from 50 to 60 feet. But we should observe, that the Adansonia, like the ochroma, and all the plants of the family of bombax, grow much more rapidly* than the dracœna, the vegetation of which is very slow. That in M. Franqui's garden still bears every year

* It is the same with the plane-tree (Platanus occidentalis) which M. Michaux measured at Marietta, on the banks of the Ohio, and which, at twenty feet from the ground, was 15·7 feet in diameter.—"Voyage à l'Ouest des Monts Alleghany," 1804, p. 93. The yew, chesnut, oak, plane-tree, deciduous cypress, bombax, mimosa, cæsalpinia, hymenæa, and dracæna, appear to me to be the plants which, in different climates, present specimens of the most extraordinary growth. An oak, discovered together with some Gallic helmets in 1809, in the turf pits of the department of the Somme, near the village of Yseux, seven leagues from Abbeville, was about the same size as the dragon-tree of Orotava. According to a memoir by M. Traullée, the trunk of this oak was 14 feet in diameter.

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both flowers and fruit. Its aspect forcibly exemplifies "that eternal youth of nature," which is an inexhaustible source of motion and of life.

The dracæna, which is seen only in cultivated spots in the Canary Islands, at Madeira, and Porto Santo, presents a curious phenomenon with respect to the migration of plants. It has never been found in a wild state on the continent of Africa. The East Indies is its real country. How has this tree been transplanted to Teneriffe, where it is by no means common? Does its existence prove, that, at some very distant period, the Guanches had connexions with other nations originally from Asia?*

On leaving Orotava, a narrow and stony pathway led us through a beautiful forest of chesnut trees (*el monte de Castaños*), to a site covered with brambles, some species of laurels, and arborescent heaths. The trunks of the latter grow to an extraordinary size; and the flowers with which they are loaded form an agreeable contrast, during a great part of the year, to the Hypericum canariense, which is very abundant at this height. We stopped to take in our provision of water under a solitary fir-tree. This station is known in the country by the name of Pino del Dornajito. Its height, according to the barometrical measurement of M. de Borda, is 522 toises; and it commands a magnificent prospect of the sea, and the whole of the northern part of the island. Near Pino del Dornajito, a little on the right of the pathway, is a copious spring of water, into which we plunged the thermometer, which fell to 15.4°. At a hundred toises distance from this spring is another equally limpid. If we admit that these waters indicate nearly the mean heat of the place whence they issue, we may fix the absolute elevation of the station at 520 toises, supposing the mean tempera-

* The form of the dragon-tree is exhibited in several species of the genus Dracæna, at the Cape of Good Hope, in China, and in New Zealand. But in New Zealand it is superseded by the form of the yucca; for the Dracæna borealis of Aiton is a Convallaria, of which it has all the appearance. The astringent juice, known in commerce by the name of dragon's blood, is, according to the inquiries we made on the spot, the produce of several American plants, which do not belong to the same genus, and of which some are lianas. At Laguna, toothpicks steeped in the juice of the dragon-tree are made in the nunneries, and are much extolled as highly useful for keeping the gums in a healthy state.

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ture of the coast to be 21 degrees, and allowing one degree for the decrement of caloric corresponding under this zone to 93 toises. We should not be surprised if this spring remained a little below the heat of the air, since it probably takes its source in some more elevated part of the peak, and possibly communicates with the small subterranean glaciers of which we shall speak hereafter. The accordance just observed between the barometrical and thermometrical measures is so much more striking, because in mountainous countries, with steep declivities, the springs generally indicate too great a decrement of caloric, for they unite small currents of water, which filtrate at different heights, and their temperature is consequently the mean between the temperature of these currents. The spring of Dornajito has considerable reputation in the country; and at the time I was there, it was the only one known on the road which leads to the summit of the volcano. The formation of springs demands a certain regularity in the direction and inclination of the strata. On a volcanic soil, porous and splintered rocks absorb the rain waters, and convey them to considerable depths. Hence arises that aridity observed in the greater part of the Canary Islands, notwithstanding the considerable height of their mountains, and the mass of clouds which navigators behold incessantly overhanging this archipelago.

From Pino del Dornajito to the crater of the volcano we continued to ascend without crossing a single valley; for the small ravines (*barancos*) do not merit this name. To the eye of the geologist the whole island of Teneriffe is but one mountain, the almost elliptical base of which is prolonged to the north-east, and in which may be distinguished several systems of volcanic rocks formed at different epochs. The Chahorra, or Montaña Colorada, and the Urca, considered in the country as insulated volcanoes, are only little hills abutting on the peak, and masking its pyramidal form. The great volcano, the lateral eruptions of which have given birth to vast promontories, is not however precisely in the centre of the island, and this peculiarity of structure appears the less surprising, if we recollect that, as the learned mineralogist M. Cordier has observed, it is not perhaps the small crater of the Piton which has been the principal agent in the changes undergone by the island of Teneriffe.

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Above the region of arborescent heaths, called Monte Verde, is the region of ferns. Nowhere, in the temperate zone, have I seen such an abundance of the pteris, blechnum, and asplenium; yet none of these plants have the stateliness of the arborescent ferns which, at the height of five or six hundred toises, form the principal ornament of equinoctial America. The root of the Pteris aquilina serves the inhabitants of Palma and Gomera for food; they grind it to powder, and mix with it a quantity of barley-meal. This composition, when boiled, is called *gofio;* the use of so homely an aliment is a proof of the extreme poverty of the lower order of people in the Canary Islands.

Monte Verde is intersected by several small and very arid ravines (cañadas), and the region of ferns is succeded by a wood of juniper trees and firs, which has suffered greatly from the violence of hurricanes. In this place, mentioned by some travellers under the name of Caravela,* Mr. Eden states that in the year 1705 he saw little flames, which, according to the doctrine of the naturalists of his time, he attributes to sulphurous exhalations igniting spontaneously. We continued to ascend, till we came to the rock of La Gayta and to Portillo: traversing this narrow pass between two basaltic hills, we entered the great plain of Spartium. At the time of the voyage of Lapérouse, M. Manneron had taken the levels of the peak, from the port of Orotava to this elevated plain, near 1400 toises above the level of the sea; but the want of water, and the misconduct of the guides, prevented him from taking the levels to the top of the volcano. The results of the operation, (which was two-thirds completed,) unfortunately were not sent to Europe, and the work is still to be recommenced from the sea-coast.

We spent two hours and a half in crossing the Llano del Retama, which appears like an immense sea of sand. Notwithstanding the elevation of this site, the centigrade thermometer rose in the shade toward sunset, to 13·8°, or 3·7° higher than toward noon at Monte Verde. This augmentation of heat could be attributed only to the reverberation

* "Phil. Trans.," vol. xxix, p. 317. Carabela is the name of a vessel with lateen sails. The pines of the peak formerly were used as masts of vessels.

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from the ground, and the extent of the plain. We suffered much from the suffocating dust of the pumice-stone, in which we were continually enveloped. In the midst of this plain are tufts of the *retama*, which is the Spartium nubigenum of Aiton. M. de Martinière, one of the botanists who perished in the expedition of Lapérouse, wished to introduce this beautiful shrub into Languedoc, where firewood is very scarce. It grows to the height of nine feet, and is loaded with odoriferous flowers, with which the goat hunters, that we met in our road, had decorated their hats. The goats of the peak, which are of a deep brown colour, are reckoned delicious food; they browse on the spartium, and have run wild in the deserts from time immemorial. They have been transported to Madeira, where they are preferred to the goats of Europe.

As far as the rock of Gayta, or the entrance of the extensive Llano del Retama, the peak of Teneriffe is covered with beautiful vegetation. There are no traces of recent devastation. We might have imagined ourselves scaling the side of some volcano, the fire of which had been extinguished as remotely as that of Monte Cavo, near Rome; but scarcely had we reached the plain covered with pumice-stone, when the landscape changed its aspect, and at every step we met with large blocks of obsidian thrown out by the volcano. Everything here speaks perfect solitude. A few goats and rabbits only bound across the plain. The barren region of the peak is nine square leagues; and as the lower regions viewed from this point retrograde in the distance, the island appears an immense heap of torrefied matter, hemmed round by a scanty border of vegetation.

From the region of the Spartium nubigenum we passed through narrow defiles, and small ravines hollowed at a very remote time by the torrents, first arriving at a more elevated plain (el Monton de Trigo), then at the place where we intended to pass the night. This station, which is more than 1530 toises above the coast, bears the name of the English Halt (Estancia de los Ingleses*), no doubt because most of

* This denomination was in use as early as the beginning of the last century. Mr. Eden, who corrupts all Spanish words, as do most travellers in our own times, calls it the *Stancha:* it is the Station des Rochers of M. Borda, as is proved by the barometrical heights there observed.

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the travellers, who formerly visited the peak, were Englishmen. Two inclined rocks form a kind of cavern, which affords a shelter from the winds. This point, which is higher than the summit of the Canigou, can be reached on the backs of mules; and here has ended the expedition of numbers of travellers, who on leaving Orotava hoped to have ascended to the brink of the crater. Though in the midst of summer, and under an African sky, we suffered from cold during the night. The thermometer descended as low as to five degrees. Our guides made a large fire with the dry branches of retama. Having neither tents nor cloaks, we lay down on some masses of rock, and were singularly incommoded by the flame and smoke, which the wind drove towards us. We had attempted to form a kind of screen with cloths tied together, but our enclosure took fire, which we did not perceive till the greater part had been consumed by the flames. We had never passed a night on a point so elevated, and we then little imagined that we should, one day, on the ridge of the Cordilleras, inhabit towns higher than the summit of the volcano we were to scale on the morrow. As the temperature diminished, the peak became covered with thick clouds. The appproach of night interrupts the play of the ascending current, which, during the day, rises from the plains towards the high regions of the atmosphere; and the air, in cooling, loses its capacity of suspending water. A strong northerly wind chased the clouds; the moon at intervals, shooting through the vapours, exposed its disk on a firmament of the darkest blue; and the view of the volcano threw a majestic character over the nocturnal scenery. Sometimes the peak was entirely hidden from our eyes by the fog, at other times it broke upon us in terrific proximity; and, like an enormous pyramid, threw its shadow over the clouds rolling beneath our feet.

About three in the morning, by the sombrous light of a few fir torches, we started on our journey to the summit of the Piton. We scaled the volcano on the north-east side, where the declivities are extremely steep; and after two

These heights were in 1803, according to M. Cordier, 19 inches 9·5 lines; and in 1776, according to Messrs. Borda and Varela, 19 inches 9·8 lines; the barometer at Orotava keeping within nearly a line at the same height.

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hours' toil, we reached a small plain, which, on account of its elevated position, bears the name of Alta Vista. This is the station of the *neveros*, those natives, whose occupation it is to collect ice and snow, which they sell in the neighbouring towns. Their mules, better practised in climbing mountains than those hired by travellers, reach Alta Vista, and the *neveros* are obliged to transport the snow to that place on their backs. Above this point commences the Malpays, a term by which is designated here, as well as in Mexico, Peru, and every other country subject to volcanoes, a ground destitute of vegetable mould, and covered with fragments of lava.

We turned to the right to examine the cavern of ice, which is at the elevation of 1728 toises, consequently below the limit of the perpetual snows in this zone. Probably the cold which prevails in this cavern, is owing to the same causes which perpetuate the ice in the crevices of Mount Jura and the Apennines, and on which the opinions of naturalists are still much divided. This natural ice-house of the peak has, nevertheless, none of those perpendicular openings, which give emission to the warm air, while the cold air remains undisturbed at the bottom. It would seem that the ice is preserved in it on account of its mass, and because its melting is retarded by the cold, which is the consequence of quick evaporation. This small subterraneous glacier is situated in a region, the mean temperature of which is probably not under three degrees; and it is not, like the true glaciers of the Alps, fed by the snow waters that flow from the summits of the mountains. During winter the cavern is filled with ice and snow; and as the rays of the sun do not penetrate beyond the mouth, the heats of summer are not sufficient to empty the reservoir. The existence of a natural ice-house depends, consequently, rather on the quantity of snow which enters it in winter, and the small influence of the warm winds in summer, than on the absolute elevation of the cavity, and the mean temperature of the layer of air in which it is situated. The air contained in the interior of a mountain is not easily displaced, as is exemplified by Monte Testaccio at Rome, the temperature of which is so different from that of the surrounding atmosphere. On Chimborazo enormous heaps of ice are found

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covered with sand, and, in the same manner as at the peak, far below the inferior limit of the perpetual snows.

It was near the Ice-Cavern (Cueva del Hielo), that, in the voyage of Lapérouse, Messrs. Lamanon and Mongès made their experiments on the temperature of boiling water. These naturalists found it 88·7°, the barometer at nineteen inches one line. In the kingdom of New Grenada, at the chapel of Guadaloupe, near Santa-Fe de Bogotá, I have seen water boil at 89·9°, under a pressure of 19 inches 1·9 lines. At Tambores, in the province of Popayan, Señor Caldas found the heat of boiling water 89·5°, the barometer being at 18 inches 11·6 lines. These results might lead us to suspect, that, in the experiment of M. Lamanon, the water had not reached the maximum of its temperature.

Day was beginning to dawn when we left the ice-cavern. We observed, during the twilight, a phenomenon which is not unusual on high mountains, but which the position of the volcano we were scaling rendered very striking. A layer of white and fleecy clouds concealed from us the sight of the ocean, and the lower region of the island. This layer did not appear above 800 toises high; the clouds were so uniformly spread, and kept so perfect a level, that they wore the appearance of a vast plain covered with snow. The colossal pyramid of the peak, the volcanic summits of Lancerota, of Forteventura, and the isle of Palma, were like rocks amidst this vast sea of vapours, and their black tints were in fine contrast with the whiteness of the clouds.

While we were climbing over the broken lavas of the Malpays, we perceived a very curious optical phenomenon, which lasted eight minutes. We thought we saw on the east side small rockets thrown into the air. Luminous points, about seven or eight degrees above the horizon, appeared first to move in a vertical direction; but their motion was gradually changed into a horizontal oscillation. Our fellow-travellers, our guides even, were astonished at this phenomenon, without our having made any remark on it to them. We thought, at first sight, that these luminous points, which floated in the air, indicated some new eruption of the great volcano of Lancerota; for we recollected that Bouguer and La Condamine, in scaling the volcano of Pichincha, were witnesses of the eruption of Cotopaxi. But

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the illusion soon ceased, and we found that the luminous points were the images of several stars magnified by the vapours. These images remained motionless at intervals, they then seemed to rise perpendicularly, descended sideways, and returned to the point whence they had departed. This motion lasted one or two seconds. Though we had no exact means of measuring the extent of the lateral shifting, we did not the less distinctly observe the path of the luminous point. It did not appear double from an effect of mirage, and left no trace of light behind. Bringing, with the telescope of a small sextant by Troughton, the stars into contact with the lofty summit of a mountain in Lancerota, I observed that the oscillation was constantly directed towards the same point, that is to say, towards that part of the horizon where the disk of the sun was to appear; and that, making allowance for the motion of the star in its declination, the image returned always to the same place. These appearances of lateral refraction ceased long before daylight rendered the stars quite invisible. I have faithfully related what we saw during the twilight, without undertaking to explain this extraordinary phenomenon, of which I published an account in Baron Zach's Astronomical Journal, twelve years ago. The motion of the vesicular vapours, caused by the rising of the sun; the mingling of several layers of air, the temperature and density of which were very different, no doubt contributed to produce an apparent movement of the stars in the horizontal direction. We see something similar in the strong undulations of the solar disk, when it cuts the horizon; but these undulations seldom exceed twenty seconds, while the lateral motion of the stars, observed at the peak, at more than 1800 toises, was easily distinguished by the naked eye, and seemed to exceed all that we have thought it possible to consider hitherto as the effect of the refraction of the light of the stars. On the top of the Andes, at Antisana, I observed the sun-rise, and passed the whole night at the height of 2100 toises, without noting any appearance resembling this phenomenon.

I was anxious to make an exact observation of the instant of sun-rising at an elevation so considerable as that we had reached on the peak of Teneriffe. No traveller, furnished

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with instruments, had as yet taken such an observation. I had a telescope and a chronometer, which I knew to be exceedingly correct. In the part where the sun was to appear the horizon was free from vapour. We perceived the upper limb at $4^h\ 48'\ 55''$ apparent time, and what is very remarkable, the first luminous point of the disk appeared immediately in contact with the limit of the horizon, consequently we saw the true horizon; that is to say, a part of the sea farther distant than 43 leagues. It is proved by calculation that, under the same parallel in the plain, the rising would have began at $5^h\ 1'\ 50{\cdot}4''$, or $11'\ 51{\cdot}3''$ later than at the height of the peak. The difference observed was $12'\ 55''$, which arose no doubt from the uncertainty of the refraction for a zenith distance, of which observations are wanting.

We were surprised at the extreme slowness with which the lower limb of the sun seemed to detach itself from the horizon. This limb was not visible till $4^h\ 56'\ 56''$. The disc of the sun, much flattened, was well defined; during the ascent there was neither double image nor lengthening of the lower limb. The duration of the sun's rising being triple that which we might have expected in this latitude, we must suppose that a fog-bank, very uniformly extended, concealed the true horizon, and followed the sun in its ascent. Notwithstanding the libration of the stars,* which we had observed towards the east, we could not attribute the slowness of the rising to an extraordinary refraction of the rays occasioned by the horizon of the sea; for it is precisely at the rising of the sun, as Le Gentil daily observed at Pondicherry, and as I have several times remarked at Cumana, that the horizon sinks, on account of the elevation of temperature in the stratum of the air which lies immediately over the surface of the ocean.

The road, which we were obliged to clear for ourselves across the Malpays, was extremely fatiguing. The ascent is steep, and the blocks of lava rolled from beneath our feet. I can compare this part of the road only to the Moraine of the

* A celebrated astronomer, Baron Zach, has compared this phenomenon of an apparent libration of the stars to that described in the Georgics (lib. 1, v. 365). But this passage relates only to the falling stars, which the ancients, (like the mariners of modern times) considered as a prognostic of wind.

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Alps or that mass of pebbly stones which we find at the lower extremity of the glaciers. At the peak the lava, broken into sharp pieces, leaves hollows, in which we risked falling up to our waists. Unfortunately the listlessness of our guides contributed to increase the difficulty of this ascent. Unlike the guides of the valley of Chamouni, or the nimble-footed Guanches, who could, it is asserted, seize the rabbit or wild goat in its course, our Canarian guides were models of the phlegmatic. They had wished to persuade us on the preceding evening not to go beyond the station of the rocks. Every ten minutes they sat down to rest themselves, and when unobserved they threw away the specimens of obsidian and pumice-stone, which we had carefully collected. We discovered at length that none of them had ever visited the summit of the volcano.

After three hours' walking, we reached, at the extremity of the Malpays, a small plain, called La Rambleta, from the centre of which the Piton, or Sugar-loaf, takes its rise. On the side toward Orotava the mountain resembles those pyramids with steps that are seen at Fayoum and in Mexico; for the elevated plains of Retama and Rambleta form two tiers, the first of which is four times higher than the second. If we suppose the total height of the Peak to be 1904 toises, the Rambleta is 1820 toises above the level of the sea. Here are found those spiracles, which are called by the natives the Nostrils of the Peak (Narices del Pico). Watery and heated vapours issue at intervals from several crevices in the ground, and the thermometer rose to 43·2°; M. Labillardière had found the temperature of these vapours, eight years before us, 53·7°; a difference which does not perhaps prove so much a diminution of activity in the volcano, as a local change in the heating of its internal surface. The vapours have no smell, and seem to be pure water. A short time before the great eruption of Mount Vesuvius, in 1805, M. Gay-Lussac and myself had observed that water, under the form of vapour, in the interior of the crater, did not redden paper which had been dipped in syrup of violets. I cannot, however, admit the bold hypothesis, according to which the Nostrils of the Peak are to be considered as the vents of an immense apparatus of distillation, the lower part of which is situated below the level of the sea. Since

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the time when volcanoes have been carefully studied, and the love of the marvellous has been less apparent in works on geology, well founded doubts have been raised respecting these direct and constant communications between the waters of the sea and the focus of the volcanic fire.* We may find a very simple explanation of a phenomenon, that has in it nothing very surprising. The peak is covered with snow during part of the year; we ourselves found it still so in the plain of Rambleta. Messrs. O'Donnel and Armstrong discovered in 1806 a very abundant spring in the Malpays, a hundred toises above the cavern of ice, which is perhaps fed partly by this snow. Everything consequently leads us to presume that the peak of Teneriffe, like the volcanoes of the Andes, and those of the island of Manilla, contains within itself great cavities, which are filled with atmospherical water, owing merely to filtration. The aqueous vapours exhaled by the *Narices* and crevices of the crater, are only those same waters heated by the interior surfaces down which they flow.

We had yet to scale the steepest part of the mountain, the Piton, which forms the summit. The slope of this small cone, covered with volcanic ashes, and fragments of pumice-stone, is so steep, that it would have been almost impossible to reach the top, had we not ascended by an old current of lava, the débris of which have resisted the ravages of time. These débris form a wall of scorious rock, which stretches into the midst of the loose ashes. We ascended the Piton by grasping these half-decomposed scoriæ, which often broke in our hands. We employed nearly half an hour to scale a hill, the perpendicular height of which is scarcely ninety toises. Vesuvius, three times lower than the peak of Teneriffe, is terminated by a cone of ashes almost three times higher, but with a more accessible and easy slope. Of all

* This question has been examined with much sagacity by M. Brieslak, in his "Introduzzione alla Geologia," t. ii., p. 302, 323, 347. Cotopaxi and Popocatepetl, which I saw ejecting smoke and ashes, in 1804, are farther from both the Pacific and the Gulf of the Antilles, than Grenoble is from the Mediterranean, and Orleans from the Atlantic. We must not consider the fact as merely accidental, that we have not yet discovered an active volcano more than 40 leagues distant from the ocean; but I consider the hypothesis, that the waters of the sea are absorbed, distilled, and decomposed by volcanoes, as very doubtful.

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the volcanoes which I have visited, that of Jorullo, in Mexico, is the only one that is more difficult to climb than the Peak, because the whole mountain is covered with loose ashes.

When the Sugar-loaf (el Piton) is covered with snow, as it is in the beginning of winter, the steepness of its declivity may be very dangerous to the traveller. M. Le Gros showed us the place where captain Baudin was nearly killed when he visited the Peak of Teneriffe. That officer had the courage to undertake, in company with the naturalists Advenier, Mauger, and Riedlé, an excursion to the top of the volcano about the end of December, 1797. Having reached half the height of the cone, he fell, and rolled down as far as the small plain of Rambleta; happily a heap of lava, covered with snow, hindered him from rolling farther with accelerated velocity. I have been told, that in Switzerland a traveller was suffocated by rolling down the declivity of the Col de Balme, over the compact turf of the Alps.

When we gained the summit of the Piton, we were surprised to find scarcely room enough to seat ourselves conveniently. We were stopped by a small circular wall of porphyritic lava, with a base of pitchstone, which concealed from us the view of the crater.* The west wind blew with such violence that we could scarcely stand. It was eight in the morning, and we suffered severely from the cold, though the thermometer kept a little above freezing point. For a long time we had been accustomed to a very high temperature, and the dry wind increased the feeling of cold, because it carried off every moment the small atmosphere of warm and humid air, which was formed around us from the effect of cutaneous perspiration.

The brink of the crater of the peak bears no resemblance to those of most of the other volcanoes which I have visited: for instance, the craters of Vesuvius, Jorullo, and Pichincha. In these the Piton preserves its conic figure to the very summit: the whole of their declivity is inclined the same number of degrees, and uniformly covered with a layer of pumice-stone very minutely divided; when we reach

* Called *La Caldera*, or the caldron of the peak, a denomination which recals to mind the Oules of the Pyrenees.

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the top of these volcanoes, nothing obstructs the view of the bottom of the crater. The peaks of Teneriffe and Cotopaxi, on the contrary, are of very different construction. At their summit a circular wall surrounds the crater; which wall, at a distance, has the appearance of a small cylinder placed on a truncated cone. On Cotopaxi this peculiar construction is visible to the naked eye at more than 2,000 toises distance; and no person has ever reached the crater of that volcano. On the peak of Teneriffe, the wall, which surrounds the crater like a parapet, is so high, that it would be impossible to reach the Caldera, if, on the eastern side, there was not a breach, which seems to have been the effect of a flowing of very old lava. We descended through this breach toward the bottom of the funnel, the figure of which is elliptic. Its greater axis has a direction from north-west to south-east, nearly N. 35° W. The greatest breadth of the mouth appeared to us to be 300 feet, the smallest 200 feet, which numbers agree very nearly with the measurement of MM. Verguin, Varela, and Borda.

It is easy to conceive, that the size of a crater does not depend solely on the height and mass of the mountain, of which it forms the principal air-vent. This opening is indeed seldom in direct ratio with the intensity of the volcanic fire, or with the activity of the volcano. At Vesuvius, which is but a hill compared with the Peak of Teneriffe, the diameter of the crater is five times greater. When we reflect, that very lofty volcanoes throw out less matter from their summits than from lateral openings, we should be led to think, that the lower the volcanoes, their force and activity being the same, the more considerable ought to be their craters. In fact, there are immense volcanoes in the Andes, which have but very small openings; and we might establish as a geological principle, that the most colossal mountains have craters of little extent at the summits, if the Cordilleras did not present many instances to the contrary.* I shall have occasion, in the progress of this work, to cite a number of facts, which will throw some light on what may be called the external structure of volcanoes. This structure is as varied

* The great volcanoes of Cotopaxi and Rucupichincha have craters, the diameters of which, according to my measurements, exceed 400 and 700 toises.

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as the volcanic phenomena themselves; and in order to raise ourselves to geological conceptions worthy of the greatness of nature, we must set aside the idea that all volcanoes are formed after the model of Vesuvius, Stromboli, and Etna.

The external edges of the Caldera are almost perpendicular. Their appearance is somewhat like the Somma, seen from the Atrio dei Cavalli. We descended to the bottom of the crater on a train of broken lava, from the eastern breach of the enclosure. The heat was perceptible only in a few crevices, which gave vent to aqueous vapours with a peculiar buzzing noise. Some of these funnels or crevices are on the outside of the enclosure, on the external brink of the parapet that surrounds the crater. We plunged the thermometer into them, and saw it rise rapidly to 68 and 75 degrees. It no doubt indicated a higher temperature, but we could not observe the instrument till we had drawn it up, lest we should burn our hands. M. Cordier found several crevices, the heat of which was that of boiling water. It might be thought that these vapours, which are emitted in gusts, contain muriatic or sulphurous acid; but when condensed, they have no particular taste; and experiments, which have been made with re-agents, prove that the chimneys of the peak exhale only pure water. This phenomenon, analogous to that which I observed in the crater of Jorullo, deserves the more attention, as muriatic acid abounds in the greater part of volcanoes, and as M. Vauquelin has discovered it even in the porphyritic lavas of Sarcouy in Auvergne.

I sketched on the spot a view of the interior edge of the crater, as it presented itself in the descent by the eastern break. Nothing is more striking than the manner in which these strata of lava are piled on one another, exhibiting the sinuosities of the calcareous rock of the higher Alps. These enormous ledges, sometimes horizontal, sometimes inclined and undulating, are indicative of the ancient fluidity of the whole mass, and of the combination of several deranging causes, which have determined the direction of each flow. The top of the circular wall exhibits those curious ramifications which we find in coke. The northern edge is most elevated. Towards the south-west the enclosure is considerably sunk, and an enormous mass of scorious lava seems

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glued to the extremity of the brink. On the west the rock is perforated; and a large opening gives a view of the horizon of the sea. The force of the elastic vapours perhaps formed this natural aperture, at the time of some inundation of lava thrown out from the crater.

The inside of this funnel indicates a volcano, which for thousands of years has vomited no fire but from its sides. This conclusion is not founded on the absence of great openings, which might be expected in the bottom of the Caldera. Those whose experience is founded on personal observation, know that several volcanoes, in the intervals of an eruption, appear filled up, and almost extinguished; but that in these same mountains, the crater of the volcano exhibits layers of scoriæ, rough, sonorous, and shining. We observe hillocks and intumescences caused by the action of the elastic vapours, cones of broken scoriæ, and ashes which cover the funnels. None of these phenomena characterise the crater of the peak of Teneriffe; its bottom is not in the state which ensues at the close of an eruption. From the lapse of time, and the action of the vapours, the inside walls are detached, and have covered the basin with great blocks of lithoid lavas.

The bottom of the Caldera is reached without danger. In a volcano, the activity of which is principally directed towards the summit, such as Vesuvius, the depth of the crater varies before and after each eruption; but at the peak of Teneriffe the depth appears to have remained unchanged for a long time. Eden, in 1715, estimated it at 115 feet; Cordier, in 1803, at 110 feet. Judging by mere inspection, I should have thought the funnel of still less depth. Its present state is that of a solfatara; and it is rather an object of curious investigation, than of imposing aspect. The majesty of the site consists in its elevation above the level of the sea, in the profound solitude of these lofty regions, and in the immense space over which the eye ranges from the summit of the mountain.

The wall of compact lava, forming the enclosure of the Caldera, is snow-white at its surface. The same colour prevails in the inside of the Solfatara of Puzzuoli. When we break these lavas, which might be taken at some distance for calcareous stone, we find in them a blackish brown nucleus. Porphyry, with basis of pitch-stone, is whitened

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externally by the slow action of the vapours of sulphurous acid gas. These vapours rise in abundance; and what is rather remarkable, through crevices which seem to have no communication with the apertures that emit aqueous vapours. We may be convinced of the presence of the sulphurous acid, by examining the fine crystals of sulphur, which are everywhere found in the crevices of the lava. This acid, combined with the water with which the soil is impregnated, is transformed into sulphuric acid by contact with the oxygen of the atmosphere. In general, the humidity in the crater of the peak is more to be feared than the heat; and they who seat themselves for a while on the ground find their clothes corroded. The porphyritic lavas are affected by the action of the sulphuric acid: the alumine, magnesia, soda, and metallic oxides gradually disappear; and often nothing remains but the silex, which unites in mammillary plates, like opal. These siliceous concretions,* which M. Cordier first made known, are similar to those found in the isle of Ischia, in the extinguished volcanoes of Santa Fiora, and in the Solfatara of Puzzuoli. It is not easy to form an idea of the origin of these incrustations. The aqueous vapours, discharged through great spiracles, do not contain alkali in solution, like the waters of the Geyser, in Iceland. Perhaps the soda contained in the lavas of the peak acts an important part in the formation of these deposits of silex. There may exist in the crater small crevices, the vapours of which are not of the same nature as those on which travellers, whose attention has been directed simultaneously to a great number of objects, have made experiments.

Seated on the northern brink of the crater, I dug a hole of some inches in depth; and the thermometer placed in this hole rose rapidly to 42°. Hence we may conclude what must be the heat in this solfatara at the depth of thirty or forty fathoms. The sulphur reduced into vapour is condensed into fine crystals, which however are not equal in size to those M. Dolomieu brought from Sicily. They are semi-diaphanous octohedrons, very brilliant on the surface, and of

* *Opalartiger kieselsinter*. The siliceous *gurh* of the volcanoes of the Isle of France contains, according to Klaproth, 0·72 silex, and 0·21 water; and thus comes near to opal, which Karsten considers as a hydrated silex.

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a conchoidal fracture. These masses, which will one day perhaps be objects of commerce, are constantly bedewed with sulphurous acid. I had the imprudence to wrap up a few, in order to preserve them, but I soon discovered that the acid had consumed not only the paper which contained them, but a part also of my mineralogical journal. The heat of the vapours, which issue from the crevices of the caldera, is not sufficiently great to combine the sulphur while in a state of minute division, with the oxygen of the atmospheric air; and after the experiment I have just cited on the temperature of the soil, we may presume that the sulphurous acid is formed at a certain depth,* in cavities to which the external air has free access.

The vapours of heated water, which act on the fragments of lava scattered about on the caldera, reduce certain parts of it to a state of paste. On examining, after I had reached America, those earthy and friable masses, I found crystals of sulphate of alumine. MM. Davy and Gay-Lussac have already made the ingenious remark, that two bodies highly inflammable, the metals of soda and potash, have probably an important part in the action of a volcano; now the potash necessary to the formation of alum is found not only in feldspar, mica, pumice-stone, and augite, but also in obsidian. This last substance is very common at Teneriffe, where it forms the basis of the tephrinic lava. These analogies between the peak of Teneriffe and the Solfatara of Puzzuoli, might no doubt be shown to be more numerous, if the former were more accessible, and had been frequently visited by naturalists.

An expedition to the summit of the volcano of Teneriffe is interesting, not solely on account of the great number of phenomena which are the objects of scientific research; it has still greater attractions from the picturesque beauties which it lays open to those who are feelingly alive to the majesty of nature. It is a difficult task to describe the

* An observer, in general very accurate, M. Breislack, asserts that the muriatic acid always predominates in the vapours of Vesuvius. This assertion is contrary to what M. Gay-Lussac and myself observed, before the great eruption of 1805, and while the lava was issuing from the crator. The smell of the sulphurous acid, so easy to distinguish, was perceptible at a great distance; and when the volcano threw out scoriæ, the smell was mingled with that of petroleum.

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sensations, which are the more forcible, inasmuch as they have something undefined, produced by the immensity of the space as well as by the vastness, the novelty, and the multitude of the objects, amidst which we find ourselves transported. When a traveller attempts to describe the loftiest summits of the globe, the cataracts of the great rivers, the tortuous vallies of the Andes, he incurs the danger of fatiguing his readers by the monotonous expression of his admiration. It appears to me more conformable to the plan I have proposed to myself in this narrative, to indicate the peculiar character that distinguishes each zone: we exhibit with more clearness the physiognomy of the landscape, in proportion as we endeavour to sketch its individual features, to compare them with each other, and to discover by this kind of analysis the sources of the enjoyments, furnished by the great picture of nature.

Travellers have learned by experience, that views from the summits of very lofty mountains are neither so beautiful, picturesque, nor so varied, as those from heights which do not exceed that of Vesuvius, Righi, and the Puy-de-Dôme. Colossal mountains, such as Chimborazo, Antisana, or Mount Rosa, compose so large a mass, that the plains covered with rich vegetation are seen only in the immensity of distance, and a blue and vapoury tint is uniformly spread over the landscape. The peak of Teneriffe, from its slender form and local position, unites the advantages of less lofty summits with those peculiar to very great heights. We not only discern from its top a vast expanse of sea, but we perceive also the forests of Teneriffe, and the inhabited parts of the coasts, in a proximity calculated to produce the most beautiful contrasts of form and colour. We might say, that the volcano overwhelms with its mass the little island which serves as its base, and it shoots up from the bosom of the waters to a height three times loftier than the region where the clouds float in summer. If its crater, half extinguished for ages past, shot forth flakes of fire like that of Stromboli in the Æolian Islands, the peak of Teneriffe, like a light-house, would serve to guide the mariner in a circuit of more than 260 leagues.

When we were seated on the external edge of the crater, we turned our eyes towards the north-west, where the coasts

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are studded with villages and hamlets. At our feet, masses of vapour, constantly drifted by the winds, afforded us the most variable spectacle. A uniform stratum of clouds, similar to that already described, and which separated us from the lower regions of the island, had been pierced in several places by the effect of the small currents of air, which the earth, heated by the sun, began to send towards us. The port of Orotava, its vessels at anchor, the gardens and the vineyards encircling the town, shewed themselves through an opening which seemed to enlarge every instant. From the summit of these solitary regions our eyes wandered over an inhabited world; we enjoyed the striking contrast between the bare sides of the peak, its steep declivities covered with scoriæ, its elevated plains destitute of vegetation, and the smiling aspect of the cultured country beneath. We beheld the plants divided by zones, as the temperature of the atmosphere diminished with the elevation of the site. Below the Piton, lichens begin to cover the scorious and lustrous lava: a violet,* akin to the Viola decumbens, rises on the slope of the volcano at 1740 toises of height; it takes the lead not only of the other herbaceous plants, but even of the gramina, which, in the Alps and on the ridge of the Cordilleras, form close neighbourhood with the plants of the family of the cryptogamia. Tufts of retama, loaded with flowers, adorn the vallies hollowed out by the torrents, and encumbered with the effects of the lateral eruptions. Below the retama, lies the region of ferns, bordered by the tract of the arborescent heaths. Forests of laurel, rhamnus, and arbutus, divide the ericas from the rising grounds planted with vines and fruit trees. A rich carpet of verdure extends from the plain of spartium, and the zone of the alpine plants even to the groups of the date tree and the musa, at the feet of which the ocean appears to roll. I here pass slightly over the principal features of this botanical chart, as I shall enter hereafter into some farther details respecting the geography of the plants of the island of Teneriffe.†

The seeming proximity, in which, from the summit of the peak, we behold the hamlets, the vineyards, and the gardens on the coast, is increased by the prodigious transparency of

* Viola cheiranthifolia. † See p. 114.

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the atmosphere. Notwithstanding the great distance, we could distinguish not only the houses, the sails of the vessels, and the trunks of the trees, but we could discern the vivid colouring of the vegetation of the plains. These phenomena are owing not only to the height of the site, but to the peculiar modifications of the air in warm climates. In every zone, an object placed on a level with the sea, and viewed in a horizontal direction, appears less luminous, than when seen from the top of a mountain, where vapours arrive after passing through strata of air of decreasing density. Differences equally striking are produced by the influence of climate. The surface of a lake or large river is less resplendent, when we see it at an equal distance, from the top of the higher Alps of Switzerland, than when we view it from the summit of the Cordilleras of Peru or of Mexico. In proportion as the air is pure and serene, the solution of the vapours becomes more complete, and the light loses less in its passage. When from the shores of the Pacific we ascend the elevated plain of Quito, or that of Antisana, we are struck for some days by the nearness at which we imagine we see objects which are actually seven or eight leagues distant. The peak of Teyde has not the advantage of being situated in the equinoctial region; but the dryness of the columns of air which rise perpetually above the neighbouring plains of Africa, and which the eastern winds convey with rapidity, gives to the atmosphere of the Canary Islands a transparency which not only surpasses that of the air of Naples and Sicily, but perhaps exceeds the purity of the sky of Quito and Peru. This transparency may be regarded as one of the chief causes of the beauty of landscape scenery in the torrid zone; it heightens the splendour of the vegetable colouring, and contributes to the magical effect of its harmonies and contrasts. If the mass of light, which circulates about objects, fatigues the external senses during a part of the day, the inhabitant of the southern climates has his compensation in moral enjoyment. A lucid clearness in the conceptions, and a serenity of mind, correspond with the transparency of the surrounding atmosphere. We feel these impressions without going beyond the boundaries of Europe. I appeal to travellers who have visited countries rendered famous by the great

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creations of the imagination and of art,—the favoured climes of Italy and Greece.

We prolonged in vain our stay on the summit of the Peak, awaiting the moment when we might enjoy the view of the whole of the archipelago of the Fortunate Islands:* we, however, descried Palma, Gomera, and the Great Canary, at our feet. The mountains of Lancerota, free from vapours at sunrise, were soon enveloped in thick clouds. Supposing only an ordinary refraction, the eye takes in, in calm weather, from the summit of the volcano, a surface of the globe of 5700 square leagues, equal to a fourth of the superficies of Spain. The question has often been agitated, whether it be possible to perceive the coast of Africa from the top of this colossal pyramid; but the nearest parts of that coast are still farther from Teneriffe than 2° 49′, or 56 leagues. The visual ray of the horizon from the Peak being 1° 57′, cape Bojador can be seen only on the supposition of its height being 200 toises above the level of the ocean. We are ignorant of the height of the Black Mountains near cape Bojador, as well as of that peak, called by navigators the Peñon Grande, farther to the south of this promontory. If the summit of the volcano of Teneriffe were more accessible, we should observe without doubt, in certain states of the wind, the effects of an extraordinary refraction. On perusing what Spanish and Portuguese authors relate respecting the existence of the fabulous isle of San Borondon, or Antilia, we find that it is particularly the humid wind from west-south-west, which produces in these latitudes the phenomena of the mirage. We shall not however admit with M. Vieyra, "that the play of the terrestrial refractions may render visible to the inhabitants of the Canaries the islands of Cape Verd, and even the Apalachian mountains of America."†

* Of all the small islands of the Canaries, the Rock of the East is the only one which cannot be seen, even in fine weather, from the top of the Peak. Its distance is 3° 5′, while that of the Salvage is only 2° 1′. The island of Madeira, distant 4° 29′, would be visible, if its mountains were more than 3,000 toises high.

† The American fruits, frequently thrown by the sea on the coasts of the islands of Ferro and Gomera, were formerly supposed to emanate from the plants of the island of San Borondon. This island, said to be governed by an archbishop and six bishops, and which Father Feijoo believed to be the image of the island of Ferro, reflected on a fog-bank,

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The cold we felt on the top of the Peak, was very considerable for the season. The centigrade thermometer, at a distance from the ground, and from the apertures that emitted the hot vapours, fell in the shade to 2·7°. The wind was west, and consequently opposite to that which brings to Teneriffe, during a great part of the year, the warm air that floats above the burning desert of Africa. As the temperature of the atmosphere, observed at the port of Orotava by M. Savagi, was 22·8°, the decrement of caloric was one degree every 94 toises. This result perfectly corresponds with those obtained by Lamanon and Saussure on the summits of the Peak and Etna, though in very different seasons. The tall slender form of these mountains facilitates the means of comparing the temperature of two strata of the atmosphere, which are nearly in the same perpendicular plane; and in this point of view the observations made in an excursion to the volcano of Teneriffe resemble those of an ascent in a balloon. We must nevertheless remark, that the ocean, on account of its transparency and evaporation, reflects less caloric than the plains, into the upper regions of the air; and also that summits which are surrounded by the sea are colder in summer, than mountains which rise from a continent; but this circumstance has very little influence on the decrement of atmospherical heat; the temperature of the low regions being equally diminished by the proximity of the ocean.

It is not the same with respect to the influence exercised by the direction of the wind, and the rapidity of the ascending current; the latter sometimes increases in an astonishing manner the temperature of the loftiest mountains. I have seen the thermometer rise, on the slope of the volcano of Antisana, in the kingdom of Quito, to 19°, when we were 2837 toises high. M. Labillardière has seen it, on the edge of the crater of the peak of Teneriffe, at 18·7°, though he had used every possible precaution to avoid the effect of accidental causes.

On the summit of the Peak, we beheld with admiration the azure colour of the sky. Its intensity at the zenith appeared to correspond to 41° of the cyanometer. We know,

was ceded in the 16th century, by the King of Portugal, to Lewis Perdigon, at the time the latter was preparing to take possession of it by conquest.

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by Saussure's experiment, that this intensity increases with the rarity of the air, and that the same instrument marked at the same period 39° at the priory of Chamouni, and 40° at the top of Mont Blanc. This last mountain is 540 toises higher than the volcano of Teneriffe; and if, notwithstanding this difference, the sky is observed there to be of a less deep blue, we must attribute this phenomenon to the dryness of the African air, and the proximity of the torrid zone.

We collected on the brink of the crater some air which we meant to analyse on our voyage to America. The phial remained so well corked, that on opening it ten days after, the water rushed in with impetuosity. Several experiments, made by means of nitrous gas in the narrow tube of Fontana's eudiometer, seemed to prove that the air of the crater contained 0·09° less oxygen than the air of the sea; but I have little confidence in this result obtained by means which we now consider as very inexact. The crater of the Peak has so little depth, and the air is renewed with so much facility, that it is scarcely probable the quantity of azote is greater there than on the coasts. We know also, from the experiments of MM. Gay-Lussac and Theodore de Saussure, that in the highest as well as in the lowest regions of the atmosphere, the air equally contains 0·21 of oxygen.*

We saw on the summit of the Peak no trace of psora, lecidea, or other cryptogamous plants; no insect fluttered in the air. We found however a few hymenoptera adhering to masses of sulphur moistened with sulphurous acid, and lining the mouths of the funnels. These are bees, which appear to have been attracted by the flowers of the Spartium nubigenum, and which oblique currents of air had carried up to these high regions, like the butterflies found by M. Ramond at the top of Mont Perdu. The butterflies perished from cold, while the bees on the Peak were scorched on imprudently approaching the crevices where they came in search of warmth.

* During the stay of M. Gay-Lussac and myself at the hospice of Mont Cenis, in March 1805, we collected air in the midst of a cloud loaded with electricity. This air, analysed in Volta's eudiometer, contained no hydrogen, and its purity did not differ 0·002 of oxygen from the air of Paris, which we had carried with us in phials hermetically sealed.

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Notwithstanding the heat we felt in our feet on the edge of the crater, the cone of ashes remains covered with snow during several months in winter. It is probable, that under the cap of snow considerable hollows are found, like those existing under the glaciers of Switzerland, the temperature of which is constantly less elevated than that of the soil on which they repose. The cold and violent wind, which blew from the time of sunrise, induced us to seek shelter at the foot of the Piton. Our hands and faces were nearly frozen, while our boots were burnt by the soil on which we walked. We descended in the space of a few minutes the Sugar-loaf which we had scaled with so much toil; and this rapidity was in part involuntary, for we often rolled down on the ashes. It was with regret that we quitted this solitude, this domain where Nature reigns in all her majesty. We consoled ourselves with the hope of once again visiting the Canary Islands, but this, like many other plans we then formed, has never been executed.

We traversed the Malpays but slowly; for the foot finds no sure foundation on the loose blocks of lava. Nearer the station of the rocks, the descent becomes extremely difficult; the compact short-swarded turf is so slippery, that we were obliged to incline our bodies continually backward, in order to avoid falling. In the sandy plain of Retama, the thermometer rose to 22·5°; and this heat seemed to us suffocating in comparison with the cold, which we had suffered from the air on the summit of the volcano. We were absolutely without water; our guides, not satisfied with drinking clandestinely the little supply of malmsey wine, for which we were indebted to Don Cologan's kindness, had broken our water jars. Happily the bottle which contained the air of the crater escaped unhurt.

We at length enjoyed the refreshing breeze in the beautiful region of the arborescent erica and fern; and we were enveloped in a thick bed of clouds stationary at six hundred toises above the plain. The clouds having dispersed, we remarked a phenomenon which afterwards became familiar to us on the declivities of the Cordilleras. Small currents of air chased trains of cloud with unequal velocity, and in opposite directions: they bore the appearance of streamlets of water in rapid motion and flowing in all directions, amidst a

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great mass of stagnant water. The causes of this partial motion of the clouds are probably very various; we may suppose them to arise from some impulsion at a great distance; from the slight inequalities of the soil, which reflects in a greater or less degree the radiant heat; from a difference of temperature kept up by some chemical action; or perhaps from a strong electric charge of the vesicular vapours.

As we approached the town of Orotava, we met great flocks of canaries.* These birds, well known in Europe, were in general uniformly green. Some, however, had a yellow tinge on their backs; their note was the same as that of the tame canary. It is nevertheless remarked, that those which have been taken in the island of the Great Canary, and in the islet of Monte Clara, near Lancerota, have a louder and at the same time a more harmonious song. In every zone, among birds of the same species, each flock has its peculiar note. The yellow canaries are a variety, which has taken birth in Europe; and those we saw in cages at Orotava and Santa Cruz had been bought at Cadiz, and in other ports of Spain. But of all the birds of the Canary Islands, that which has the most heart-soothing song is unknown in Europe. It is the capirote, which no effort has succeeded in taming, so sacred to his soul is liberty. I have stood listening in admiration of his soft and melodious warbling, in a garden at Orotava; but I have never seen him sufficiently near to ascertain to what family he belongs. As to the parrots, which were supposed to have been seen at the period of captain Cook's abode at Teneriffe, they never existed but in the narratives of a few travellers, who have copied from each other. Neither parrots nor monkeys inhabit the Canary Islands; and though in the New Continent the former migrate as far as North Carolina, I doubt whether in the Old they have ever been met with beyond the 28th degree of north latitude.

Toward the close of day we reached the port of Orotava, where we received the unexpected intelligence that the Pizarro would not set sail till the 24th or 25th. If we could have calculated on this delay, we should either have lengthened

* Fringilla Canaria. La Caille relates, in the narrative of his voyage to the Cape, that on Salvage Island these canaries are so abundant, that you cannot walk there in a certain season without breaking their eggs.

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our stay on the Peak,* or have made an excursion to the volcano of Chahorra. We passed the following day in visiting the environs of Orotava, and enjoying the agreeable company we found at Don Cologan's. We perceived that Teneriffe had attractions not only to those who devote themselves to the study of nature: we found at Orotava several persons possessing a taste for literature and music, and who have transplanted into these distant climes the amenity of European society. In these respects the Canary Islands have no great resemblance to the other Spanish colonies, excepting the Havannah.

We were present on the eve of St. John at a pastoral fête in the garden of Mr. Little. This gentleman, who rendered great service to the Canarians during the last famine, has cultivated a hill covered with volcanic substances. He has formed in this delicious site an English garden, whence there is a magnificent view of the Peak, of the villages along the coast, and the isle of Palma, which is bounded by the vast expanse of the Atlantic. I cannot compare this prospect with any, except the views of the bays of Genoa and Naples; but Orotava is greatly superior to both in the magnitude of the masses and in the richness of vegetation. In the beginning of the evening the slope of the volcano exhibited on a sudden a most extraordinary spectacle. The shepherds, in conformity to a custom, no doubt introduced by the Spaniards, though it dates from the highest antiquity, had lighted the fires of St. John. The scattered masses of fire and the columns of smoke driven by the wind, formed a fine contrast with the deep verdure of the forests which covered the sides of the Peak. Shouts of joy resounding

* As a great number of travellers who land at Santa Cruz, do not undertake the excursion to the Peak, because they are ignorant of the time it occupies, it may be useful to lay down the following data: In making use of mules as far as the Estancia de los Ingleses, it takes twenty-one hours from Orotava to arrive at the summit of the Peak, and return to the port; namely, from Orotava to the Pino del Dornajito three hours; from the Pino to the Station of the Rocks six hours; and from this station to the Caldera three hours and a half. I reckon nine hours for the descent. In this calculation I count only the time employed in walking, without reckoning that which is necessary for examining the productions of the Peak, or for taking rest. Half a day is sufficient for going from Santa Cruz to Orotava.

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from afar were the only sounds that broke the silence of nature in these solitary regions.

Don Cologan's family has a country-house nearer the coast than that I have just mentioned. This house, called La Paz, is connected with a circumstance that rendered it peculiarly interesting to us. M. de Borda, whose death we deplored, was its inmate during his last visit to the Canary Islands. It was in a neighbouring plain that he measured the base, by which he determined the height of the Peak. In this geometrical operation the great dracæna of Orotava served as a mark. Should any well-informed traveller at some future day undertake a new measurement of the volcano with more exactness, and by the help of astronomical repeating circles, he ought to measure the base, not near Orotaval, but near Los Silos, at a place called Bante. According to M. Broussonnet there is no plain near the Peak of greater extent. In herborizing near La Paz we found a great quantity of Lichen roccella on the basaltic rocks bathed by the waters of the sea. The archil of the Canaries is a very ancient branch of commerce; this lichen is however found in less abundance in the island of Teneriffe than in the desert islands of Salvage, La Graciosa, and Alegranza, or even in Canary and Hierro. We left the port of Orotava on the 24th of June.

To avoid disconnecting the narrative of the excursion to the top of the Peak, I have said nothing of the geological observations I made on the structure of this colossal mountain, and on the nature of the volcanic rocks of which it is composed. Before we quit the archipelago of the Canaries, I shall linger for a moment, and bring into one point of view some facts relating to the physical aspect of those countries.

Mineralogists who think that the end of the geology of volcanoes is the classification of lavas, the examination of the crystals they contain, and their description according to their external characters, are generally very well satisfied when they come back from the mouth of a burning volcano. They return loaded with those numerous collections, which are the principal objects of their research. This is not the feeling of those who, without confounding descriptive mineralogy (oryctognosy) with geognosy, endeavour to raise them-

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selves to ideas generally interesting, and seek, in the study of nature, for answers to the following questions:—

Is the conical mountain of a volcano entirely formed of liquified matter heaped together by successive eruptions, or does it contain in its centre a nucleus of primitive rocks covered with lava, which are these same rocks altered by fire? What are the affinities which unite the productions of modern volcanoes with the basalts, the phonolites, and those porphyries with bases of feldspar, which are without quartz, and which cover the Cordilleras of Peru and Mexico, as well as the small groups of the Monts Dorés, of Cantal, and of Mézen in France? Has the central nucleus of volcanoes been heated in its primitive position, and raised up, in a softened state, by the force of the elastic vapours, before these fluids communicated, by means of a crater, with the external air? What is the substance, which, for thousands of years, keeps up this combustion, sometimes so slow, and at other times so active? Does this unknown cause act at an immense depth; or does this chemical action take place in secondary rocks lying on granite?

The farther we are from finding a solution of these problems in the numerous works hitherto published on Etna and Vesuvius, the greater is the desire of the traveller to see with his own eyes. He hopes to be more fortunate than those who have preceded him; he wishes to form a precise idea of the geological relations which the volcano and the neighbouring mountains bear to each other: but how often is he disappointed, when, on the limits of the primitive soil, enormous banks of tufa and puzzolana render every observation on the position and stratification impossible! We reach the inside of the crater with less difficulty than we at first expect; we examine the cone from its summit to its base; we are struck with the difference in the produce of each eruption, and with the analogy which still exists between the lavas of the same volcano; but, notwithstanding the care with which we interrogate nature, and the number of partial observations which present themselves at every step, we return from the summit of a burning volcano less satisfied than when we were preparing to visit it. It is after we have studied them on the spot, that the volcanic phenomena

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appear still more isolated, more variable, more obscure, than we imagine them when consulting the narratives of travellers.

These reflections occurred to me on descending from the summit of the peak of Teneriffe, the first unextinct volcano I had yet visited. They returned anew whenever, in South America, or in Mexico, I had occasion to examine volcanic mountains. When we reflect how little the labours of mineralogists, and the discoveries in chemistry, have promoted the knowledge of the physical geology of mountains, we cannot help being affected with a painful sentiment; and this is felt still more strongly by those, who, studying nature in different climates, are more occupied by the problems they have not been able to solve, than with the few results they have obtained.

The peak of Ayadyrma, or of Echeyde,* is a conic and isolated mountain, which rises in an islet of very small circumference. Those who do not take into consideration the whole surface of the globe, believe, that these three circumstances are common to the greater part of volcanoes. They cite, in support of their opinion, Etna, the peak of the Azores, the Solfatara of Guadaloupe, the Trois-Salazes of the isle of Bourbon, and the clusters of volcanoes in the Indian Sea and in the Atlantic. In Europe and in Asia, as far as the interior of the latter continent is known, no burning volcano is situated in the chains of mountains; all being at a greater or less distance from those chains. In the New World, on the contrary, (and this fact deserves the greatest attention,) the volcanoes the most stupendous for their masses form a part of the Cordilleras themselves. The mountains of mica-slate and gneiss in Peru and New Grenada immediately touch the volcanic porphyries of the provinces of Quito and Pasto. To the south and north of these countries, in Chile and in the kingdom of Guatimala, the active volcanoes are grouped in rows. They are the continuation, as we may say, of the chains of primitive rocks; and if the volcanic fire has broken forth in some plain remote from the Cordilleras, as in mount Sangay and Jorullo,† we

* The word Echeyde, which signifies Hell in the language of the Guanches, has been corrupted by the Europeans into Teyde.

† Two volcanoes of the Provinces of Quixos and Mechoacan, the one in the southern, and the other in the northern hemisphere.

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must consider this phenomenon as an exception to the law, which nature seems to have imposed on these regions. I may here repeat these geological facts, because this presumed isolated situation of every volcano has been cited in opposition to the idea that the peak of Teneriffe, and the other volcanic summits of the Canary Islands, are the remains of a submerged chain of mountains. The observations which have been made on the grouping of volcanoes in America, prove that the ancient state of things represented in the conjectural map of the Atlantic by M. Bory de St. Vincent* is by no means contradictory to the acknowledged laws of nature; and that nothing opposes the supposition that the summits of Porto Santo, Madeira, and the Fortunate Islands, may heretofore have formed, either a distinct range of primitive mountains, or the western extremity of the chain of the Atlas.

The peak of Teyde forms a pyramidal mass like Etna, Tungurahua, and Popocatepetl. This physiognomic character is very far from being common to all volcanoes. We have seen some in the southern hemisphere, which, instead of having the form of a cone or a bell, are lengthened in one direction, having the ridge sometimes smooth, and at others bristled with small pointed rocks. This structure is peculiar to Antisana and Pichincha, two burning mountains of the province of Quito; and the absence of the conic form ought never to be considered as a reason excluding the idea of a volcanic origin. I shall develope, in the progress of this work, some of the analogies, which I think I have perceived between the physiognomy of volcanoes and the antiquity of their rocks. It is sufficient to state, generally speaking, that the summits, which are still subject to eruptions of the greatest violence, and at the nearest periods to each other, are *slender peaks* of a conic form; that the mountains with *lengthened summits*, and rugged with small stony

* Whether the traditions of the ancients respecting the Atlantis are founded on historical facts, is a matter totally distinct from the question whether the archipelago of the Canaries and the adjacent islands are the vestiges of a chain of mountains, rent and sunk in the sea during one of the great convulsions of our globe. I do not pretend to form any opinion in favour of the existence of the Atlantis; but I endeavour to prove, that the Canaries have no more been created by volcanoes, than the whole body of the smaller Antilles has been formed by madrepores.

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masses, are very old volcanoes, and near being extinguished; and that rounded tops, in the form of domes, or bells, indicate those problematic porphyries, which are supposed to have been heated in their primitive position, penetrated by vapours, and forced up in a mollified state, without having ever flowed as real lithoidal lavas. To the first class belong Cotopaxi, the peak of Teneriffe, and the peak of Orizava in Mexico. In the second may be placed Cargueirazo and Pichincha, in the province of Quito; the volcano of Puracey, near Popayan; and perhaps also Hecla, in Iceland. In the third and last we may rank the majestic figure of Chimborazo, and, (if it be allowable to place by the side of that colossus a hill of Europe,) the Great Sarcouy in Auvergne.

In order to form a more exact idea of the external structure of volcanoes, it is important to compare their perpendicular height with their circumference. This, however, cannot be done with any exactness, unless the mountains are isolated, and rising on a plain nearly on a level with the sea. In calculating the circumference of the peak of Teneriffe in a curve passing through the port of Orotava, Garachico, Adexe, and Guimar, and setting aside the prolongations of its base towards the forest of Laguna, and the north-east cape of the island, we find that this extent is more than 54,000 toises. The height of the Peak is consequently one twenty-eighth of the circumference of its basis. M. von Buch found a thirty-third for Vesuvius; and, which perhaps is less certain, a thirty-fourth for Etna.* If the slope of these three volcanoes were uniform from the summit to the base, the peak of Teyde would have an inclination of 12° 29′, Vesuvius 12° 41′, and Etna 10° 13′: a result which must astonish those who do not reflect on what constitutes an average slope. In a very long ascent, slopes

* Gilbert, Annalen der Physik, B. 5, p. 455. Vesuvius is 133,000 palmas, or eighteen nautical miles in circumference. The horizontal distance from Resina to the crater is 3,700 toises. Italian mineralogists have estimated the circumference of Etna at 840,000 palmas, or 119 miles. With these data, the ratio of the height to the circumference would be only a seventy-second; but I find on tracing a curve through Catania, Palermo, Bronte, and Piemonte, only 62 miles in circumference. according to the best maps. This increases the ratio to a fifty-fourth. Does the basis fall on the outside of the curve that I assume?

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of three or four degrees alternate with others which are inclined from 25 to 30 degrees; and the latter only strike our imagination, because we think all the slopes of mountains more steep than they really are. I may cite in support of this consideration the example of the ascent from the port of Vera Cruz to the elevated plain of Mexico. On the eastern slope of the Cordillera a road has been traced, which for ages has not been frequented except on foot, or on the backs of mules. From Encéro to the small Indian village of Las Vigas, there are 7500 toises of horizontal distance; and Encero being, according to my barometric measurement, 746 toises lower than Las Vigas, the result, for the mean slope, is only an angle of 5° 40′.

In the note at the foot of this page will be seen the results of some experiments I have made on the difficulties arising from the declivities in mountainous countries.*

Isolated volcanoes, in the most distant regions, are very analogous in their structure. At great elevations all have considerable plains, in the middle of which arises a cone perfectly circular. Thus at Cotopaxi the plains of Suniguaicu extend beyond the farm of Pansache. The stony summit of Antisana, covered with eternal snow, forms an islet in the midst of an immense plain, the surface of which is twelve leagues square, while its height exceeds that of the peak of Teneriffe by two hundred toises. At Vesuvius,

* In places where there were at the same time slopes covered with tufted grass and loose sands, I took the following measures:—

5°, slope of a very marked inclination. In France the high roads must not exceed 4° 46′ by law;

15°, slope extremely steep, and which we cannot descend in a carriage;

37°, slope almost inaccessible on foot, if the ground be naked rock, or turf too thick to form steps. The body falls backwards when the tibia makes a smaller angle than 53° with the sole of the foot;

42°, the steepest slope that can be climbed on foot in a ground that is sandy, or covered with volcanic ashes.

When the slope is 44°, it is almost impossible to scale it, though the ground permits the forming of steps by thrusting in the foot. The cones of volcanoes have a medium slope from 33° to 40°. The steepest parts of these cones, either of Vesuvius, the Peak of Teneriffe, the volcano of Pichincha, or Jorullo, are from 40° to 42°. A slope of 55° is quite inaccessible. If seen from above it would be estimated at 75°.

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at three hundred and seventy toises high, the cone detaches itself from the plain of Atrio dei Cavalli. The peak of Teneriffe presents two of these elevated plains, the uppermost of which, at the foot of the Piton, is as high as Etna, and of very little extent; while the lowermost, covered with tufts of retama, reaches as far as the Estancia de los Ingleses. This rises above the level of the sea almost as high as the city of Quito, and the summit of Mount Lebanon.

The greater the quantity of matter that has issued from the crater of a mountain, the more elevated is its cone of ashes in proportion to the perpendicular height of the volcano itself. Nothing is more striking, under this point of view, than the difference of structure between Vesuvius, the peak of Teneriffe, and Pichincha. I have chosen this last volcano in preference, because its summit* enters scarcely within the limit of the perpetual snows. The cone of Cotopaxi, the form of which is the most elegant and most regular known, is 540 toises in height; but it is impossible to decide whether the whole of this mass is covered with ashes.

Names of the volcanoes.	Total height in toises.	Height of the cone covered with ashes.	Proportion of the cone to the total height.
Vesuvius . .	606	200	$\frac{1}{3}$
Peak of Teneriffe .	1904	84	$\frac{1}{22}$
Pichincha . .	2490	240	$\frac{1}{10}$

This table seems to indicate, what we shall have an opportunity of proving more amply hereafter, that the peak of Teneriffe belongs to that group of great volcanoes, which, like Etna and Antisana, have had more copious eruptions from their sides than from their summits. Thus the crater at the extremity of the Piton, which is called the Caldera,

* I have measured the summit of Pichincha, that is the small mountain covered with ashes above the Llano del Vulcan, to the north of Alto de Chuquira. This mountain has not, however, the regular form of a cone. As to Vesuvius, I have indicated the mean height of the Sugar-loaf, on account of the great difference between the two edges of the crater.

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is extremely small. Its diminutive size struck M. de Borda, and other travellers, who took little interest in geological investigations.

As to the nature of the rocks which compose the soil of Teneriffe, we must first distinguish between productions of the present volcano, and the range of basaltic mountains which surround the Peak, and which do not rise more than five or six hundred toises above the level of the ocean. Here, as well as in Italy, Mexico, and the Cordilleras of Quito, the rocks of trap-formation * are at a distance from the recent currents of lava; everything shows that these two classes of substances, though they owe their origin to similar phenomena, date from very different periods. It is important to geology not to confound the modern currents of lava, the heaps of basalt, green-stone, and phonolite, dispersed over the primitive and secondary formations, with those porphyroid masses having bases of compact feldspar,† which perhaps have never been perfectly liquified, but which do not less belong to the domain of volcanoes.

In the island of Teneriffe, strata of tufa, puzzolana, and clay, separate the range of basaltic hills from the currents of recent lithoid lava, and from the eruptions of the present volcano. In the same manner as the eruptions of Epomeo in the island of Ischia, and those of Jorullo in Mexico, have taken place in countries covered with trappean porphyry, ancient basalt, and volcanic ashes, so the peak of Teyde has raised itself amidst the wrecks of submarine volcanoes. Notwithstanding the difference of composition in the recent lavas of the Peak, there is a certain regularity of position, which must strike the naturalist least skilled in geognosy. The great elevated plain of Retama separates the black, basaltic, and earthlike lava, from the vitreous and feldsparry

* The trap-formation includes the basalts, green-stone (*grunstein*), the trappean porphyries, the phonolites or porphyrschiefer, &c.

† These petrosiliceous masses contain vitreous and often calcined crystals of feldspar, of amphibole, of pyroxene, a little of olivine, but scarcely any quartz. To this very ambiguous formation belong the trappean porphyries of Chimborazo and of Riobamba in America, of the Euganean mountains in Italy, and of the Siebengebirge in Germany; as well as the *domites* of the Great-Sarcouy, of Puy-de-Dôme, of the Little Cleirsou, and of one part of the Puy-Chopine in Auvergne.

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lava, the basis of which is obsidian, pitch-stone, and phonolite. This phenomenon is the more remarkable, inasmuch as in Bohemia and in other parts of Europe, the porphyrschiefer with base of phonolite* covers also the convex summits of basaltic mountains.

It has already been observed, that from the level of the sea to Portillo, and as far as the entrance on the elevated plain of the Retama, that is, two-thirds of the total height of the volcano, the ground is so covered with plants, that it is difficult to make geological observations. The currents of lava, which we discover on the slope of Monte Verde, between the beautiful spring of Dornajito and Caravela, are black masses, altered by decomposition, sometimes porous, and with very oblong pores. The basis of these lower lavas is rather wacke than basalt; when it is spongy, it resembles the amygdaloids† of Frankfort-on-the-Maine. Its fracture is generally irregular; wherever it is conchoidal, we may presume that the cooling has been more rapid, and the mass has been exposed to a less powerful pressure. These currents of lava are not divided into regular prisms, but into very thin layers, not very regular in their inclination; they contain much olivine, small grains of magnetic iron, and augite, the colour of which often varies from deep leek-green to olive green, and which might be mistaken for crystallized olivine, though no transition from one to the other of these substances exists.‡ Amphibole is in general very rare at Teneriffe, not only in the modern lithoid lavas, but also in the ancient basalts, as has been observed by M. Cordier, who resided longer at the Canaries than any other mineralogist. Nepheline, leucite, idocrase, and meionite have not yet been seen at the peak of Teneriffe; for a reddish-gray lava, which we found on the slope of Monte Verde, and which contains small microscopic crystals, appears to me to be a close mixture of basalt and anal-

* Klingstein. Werner.

† Wakkenartiger mandelstein. Steinkaute.

‡ Steffens, Handbuch der Oryktognosie, tom. i, s. 364. The crystals which Mr. Friesleben and myself have made known under the denomination of foliated olivine (*blättriger olivin*) belong, according to Mr. Karsten, to the pyroxene augite. Journal des Mines de Freiberg, 1791, p. 215.

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cime.* In like manner the lava of Scala, with which the city of Naples is paved, contains a close mixture of basalt, nepheline, and leucite. With respect to this last substance, which has hitherto been observed only at Vesuvius and in the environs of Rome, it exists perhaps at the peak of Teneriffe, in the old currents of lava now covered by more recent ejections. Vesuvius, during a long series of years, has also thrown out lavas without leucites: and if it be true, as M. von Buch has rendered very probable, that these crystals are formed only in the currents which flow either from the crater itself, or very near its brink, we must not be surprised at not finding them in the lavas of the peak. The latter almost all proceed from lateral eruptions, and consequently have been exposed to an enormous pressure in the interior of the volcano.

In the plain of Retama, the basaltic lavas disappear under heaps of ashes, and pumice-stone reduced to powder. Thence to the summit, from 1,500 to 1,900 toises in height, the volcano exhibits only vitreous lava with bases of pitch-stone† and obsidian. These lavas, destitute of amphibole and mica, are of a blackish brown, often varying to the deepest olive green. They contain large crystals of feldspar, which are not fissured, and seldom vitreous. The analogy of those decidedly volcanic masses with the resinite porphyries‡ of the valley of Tribisch in Saxony is very remarkable; but the latter, which belong to an extended and metalliferous formation of porphyry, often contain quartz, which is wanting in the modern lavas. When the basis of the lavas of the Malpays changes from pitchstone to obsidian, its colour is paler, and is mixed with gray; in this case, the feldspar passes by imperceptible gradations from the common to the vitreous. Sometimes both varieties meet in the same fragment, as we observed also in the trappean porphyries of the valley of Mexico. The feldsparry lavas of the Peak, of a much less black tinge than those of Arso in the island of

* This substance, which M. Dolomieu discovered in the amygdaloids of Catania in Sicily, and which accompanies the stilbites of Fassa in Tyrol, forms, with the chabasie of Haüy, the genus Cubicit of Werner. M. Cordier found at Teneriffe xeolite in an amygdaloid which covers the basalts of La Punta di Naga.

† Petrosilex resinite. Haüy.

‡ Pechstein-porphyr. Werner.

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Ischia, whiten at the edge of the crater from the effect of the acid vapours; but internally they are not found to be colourless like that of the feldsparry lavas of the Solfatara at Naples, which perfectly resemble the trappean porphyries at the foot of Chimborazo. In the middle of the Malpays, at the height of the cavern of ice, we found among the vitreous lavas with pitch-stone and obsidian bases, blocks of real greenish-gray, or mountain-green phonolite, with a smooth fracture, and divided into thin laminæ, sonorous and keen edged. These masses were the same as the porphyr-schiefer of the mountain of Bilin in Bohemia; we recognised in them small long crystals of vitreous feldspar.

This regular disposition of lithoid basaltic lava and feldsparry vitreous lava is analogous to the phenomena of all trappean mountains; it reminds us of those phonolites lying in very ancient basalts, those close mixtures of augite and feldspar which cover the hills of wacke or porous amygdaloids: but why are the porphyritic or feldsparry lavas of the Peak found only on the summit of the volcano? Should we conclude from this position that they are of more recent formation than the lithoid basaltic lava, which contains olivine and augite? I cannot admit this last hypothesis; for lateral eruptions may have covered the feldsparry nucleus, at a period when the crater had ceased its activity. At Vesuvius also, we perceive small crystals of vitreous feldspar only in the very ancient lavas of the Somma. These lavas, setting aside the leucite, very nearly resemble the phonolitic ejections of the Peak of Teneriffe. In general, the farther we go back from the period of modern eruptions, the more the currents increase both in size and extent, acquiring the character of rocks, by the regularity of their position, by their division into parallel strata, or by their independence of the present form of the ground.

The Peak of Teneriffe is, next to Lipari, the volcano that has produced most obsidian. This abundance is the more striking, as in other regions of the earth, in Iceland, in Hungary, in Mexico, and in the kingdom of Quito, we meet with obsidians only at great distances from burning volcanoes. Sometimes they are scattered over the fields in angular pieces; for instance, near Popayan, in South America; at other times they form isolated rocks, as at Quinche, near

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Quito. In other places (and this circumstance is very remarkable), they are disseminated in pearl-stone, as at Cinapecuaro, in the province of Mechoacan,* and at the Cabo de Gates, in Spain. At the peak of Teneriffe the obsidian is not found towards the base of the volcano, which is covered with modern lava: it is frequent only towards the summit, especially from the plain of Retama, where very fine specimens may be collected. This peculiar position, and the circumstance that the obsidian of the Peak has been ejected by a crater which for ages past has thrown out no flames, favour the opinion, that volcanic vitrifications, wherever they are found, are to be considered as of very ancient formation.

Obsidian, jade, and Lydian-stone,† are three minerals, which nations ignorant of the use of copper or iron, have in all ages employed for making keen-edged weapons. We see that wandering hordes have dragged with them, in their distant journeys, stones, the natural position of which the mineralogist has not yet been able to determine. Hatchets of jade, covered with Aztec hieroglyphics, which I brought from Mexico, resemble both in their form and nature those made use of by the Gauls, and those we find among the South Sea islanders. The Mexicans dug obsidian from mines, which were of vast extent; and they employed it for making knives, sword-blades, and razors. In like manner the Guanches, (in whose language obsidian was called *tabona,*) fixed splinters of that mineral to the ends of their lances They carried on a considerable trade in it with the neighbouring islands; and from the consumption thus occasioned, and the quantity of obsidian which must have been broken in the course of manufacture, we may presume that this mineral has become scarce from the lapse of ages. We are surprised to see an Atlantic nation substituting, like the natives of America, vitrified lava for iron. In both countries this variety of lava was employed as an object of ornament: and the inhabitants of Quito made beautiful looking-glasses with an obsidian divided into parallel laminæ.

There are three varieties of obsidian at the Peak. Some form enormous blocks, several toises long, and often of a spheroidal shape. We might suppose that they had been

* To the west of the city of Mexico.

† Lydischerstein.

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thrown out in a softened state, and had afterwards been subject to a rotary motion. They contain a quantity of vitreous feldspar, of a snow-white colour, and the most brilliant pearly lustre. These obsidians are, nevertheless, but little transparent on the edges; they are almost opaque, of a brownish black, and of an imperfect conchoidal fracture. They pass into pitch-stone; and we may consider them as porphyries with a basis of obsidian. The second variety is found in fragments much less considerable. It is in general of a greenish black, sometimes of murky gray, very seldom of a perfect black, like the obsidian of Hecla and Mexico. Its fracture is perfectly conchoidal, and it is extremely transparent on the edges. I have found in it neither amphibole nor pyroxene, but some small white points, which seem to be feldspar. None of the obsidians of the Peak appear in those gray masses of pearl or lavender-blue, striped, and in separate wedge-formed pieces, like the obsidian of Quito, Mexico, and Lipari, and which resemble the fibrous plates of the crystalites of our glass-houses, on which Sir James Hall, Dr. Thompson, and M. de Bellevue, have published some curious observations.*

The third variety of obsidian of the Peak is the most remarkable of the whole, from its connexion with pumice-stone. It is, like that above described, of a greenish black, sometimes of a murky gray, but its very thin plates alternate with layers of pumice-stone. Dr. Thomson's fine collection at Naples contained similar examples of lithoid lava of Vesuvius, divided into very distinct plates, only a line thick. The fibres of the pumice-stone of the Peak are very seldom parallel to each other, and perpendicular to the strata of obsidian; they are most commonly irregular, asbestoidal, like fibrous glass-gall; and instead of being disseminated in the obsidian, like crystalites, they are found simply adhering to one of the external surfaces of this substance. During my stay at Madrid, M. Hergen showed me several specimens in the mineralogical collection of Don Jose Clavijo; and for

* The name crystalites has been given to the crystalized thin plates observed in glass cooling slowly. The term *glastenized glass* is employed by Dr. Thompson and others to indicate glass which by slow cooling is wholly unvitrified, and has assumed the appearance of a fossil substance, or real *glass-stone*.

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a long time the Spanish mineralogists considered them as furnishing undoubted proofs, that pumice-stone owes its origin to obsidian, in some degree deprived of colour, and swelled by volcanic fire. I was formerly of this opinion, which, however, must be understood to refer to one variety only of pumice. I even thought, with many other geologists, that obsidian, so far from being vitrified lava, belonged to rocks that were not volcanic; and that the fire, forcing its way through the basalts, the green-stone rocks, the phonolites, and the porphyries with bases of pitchstone and obsidian, the lavas and pumice-stone were no other than these same rocks altered by the action of the volcanoes. The deprivation of colour and extraordinary swelling which the greater part of the obsidians undergo in a forge-fire, their transition into pitch-stone, and their position in regions very distant from burning volcanoes, appear to be phenomena very difficult to reconcile, when we consider the obsidians as volcanic glass. A more profound study of nature, new journeys, and observations made on the productions of burning volcanoes, have led me to renounce those ideas.

It appears to me at present extremely probable, that obsidians, and porphyries with bases of obsidian, are vitrified masses, the cooling of which has been too rapid to change them into lithoid lava. I consider even the pearlstone as an unvitrified obsidian: for among the minerals in the King's cabinet at Berlin there are volcanic glasses from Lipari, in which we see striated crystalites, of a pearl-gray colour, and of an earthy appearance, forming gradual approaches to a granular lithoid lava, like the pearlstone of Cinapecuaro, in Mexico. The oblong bubbles observed in the obsidians of every continent are incontestible proofs of their ancient state of igneous fluidity; and Dr. Thompson possesses specimens from Lipari, which are very instructive in this point of view, because fragments of red porphyry, or porphyry lavas, which do not entirely fill up the cavities of the obsidian, are found enveloped in them. We might say, that these fragments had not time to enter into complete solution in the liquified mass. They contain vitreous feldspar, and augite, and are the same as the celebrated columnar porphyries of the island of Panaria, which, without having been part of a current of lava, seem raised up in the

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form of hillocks, like many of the porphyries in Auvergne, in the Euganean mountains, and in the Cordilleras of the Andes.

The objections against the volcanic origin of obsidians, founded on their speedy loss of colour, and their swelling by a slow fire, have been shaken by the ingenious experiments of Sir James Hall. These experiments prove, that a stone which is fusible only at thirty-eight degrees of Wedgwood's pyrometer, yields a glass that softens at fourteen degrees; and that this glass, melted again and unvitrified (glastenized), is fusible again only at thirty-five degree of the same pyrometer. I applied the blowpipe to some black pumice-stone from the volcano of the isle of Bourbon, which, on the slightest contact with the flame, whitened and melted into an enamel.

But whether obsidians be primitive rocks which have undergone the action of volcanic fire, or lavas repeatedly melted within the crater, the origin of the pumice-stones contained in the obsidian of the Peak of Teneriffe is not less problematic. This subject is the more worthy of being investigated, since it is generally interesting to the geology of volcanoes; and since that excellent mineralogist, M. Fleuriau de Bellevue, after having examined Italy and the adjacent islands with great attention, affirms, that it is highly improbable that pumice-stone owes its origin to the swelling of obsidian.

The experiments of M. da Camara, and those I made in 1802, tend to support the opinion, that the pumice stones adherent to the obsidians of the Peak of Teneriffe do not unite to them accidentally, but are produced by the expansion of an elastic fluid, which is disengaged from the compact vitreous matter. This idea had for a long time occupied the mind of a person highly distinguished for his talents and reputation at Quito, who, unacquainted with the labours of the mineralogists of Europe, had devoted himself to researches on the volcanoes of his country. Don Juan de Larea, one of those men lately sacrificed to the fury of faction, had been struck with the phenomena exhibited by obsidians exposed to a white heat. He had thought, that, wherever volcanoes act in the centre of a country covered with porphyry with base of obsidian, the elastic fluids must cause a swelling of the liquified mass, and perform an important part in

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the earthquakes preceding eruptions. Without adopting an opinion, which seems somewhat bold, I made, in concert with M. Larea, a series of experiments on the tumefaction of the volcanic vitreous substances at Teneriffe, and on those which are found at Quinche, in the kingdom of Quito. To judge of the augmentation of their bulk, we measured pieces exposed to a forge-fire of moderate heat, by the water they displaced from a cylindric glass, enveloping the spongy mass with a thin coating of wax. According to our experiments, the obsidians swelled very unequally: those of the Peak and the black varities of Cotopaxi and of Quinche increased nearly five times their bulk.

The colour of the pumice-stones of the Peak leads to another important observation. The sea of white ashes which encircles the Piton, and covers the vast plain of Retama, is a certain proof of the former activity of the crater: for in all volcanoes, even when there are lateral eruptions, the ashes and the rapilli issue conjointly with the vapours only from the opening at the summit of the mountain. Now, at Teneriffe, the black rapilli extend from the foot of the Peak to the sea-shore; while the white ashes, which are only pumice ground to powder, and among which I have discovered, with a lens, fragments of vitreous feldspar and pyroxene, exclusively occupy the region next to the Peak. This peculiar distribution seems to confirm the observations made long ago at Vesuvius, that the white ashes are thrown out last, and indicate the end of the eruption. In proportion as the elasticity of the vapours diminishes, the matter is thrown to a less distance; and the black rapilli, which issue first, when the lava has ceased running, must necessarily reach farther than the white rapilli. The latter appear to have been exposed to the action of a more intense fire.

I have now examined the exterior structure of the Peak, and the composition of its volcanic productions, from the region of the coast to the top of the Piton:—I have endeavoured to render these researches interesting, by comparing the phenomena of the volcano of Teneriffe with those that are observed in other regions, the soil of which is equally undermined by subterranean fires. This mode of viewing Nature in the universality of her relations is no doubt ad-

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verse to the rapidity desirable in an itinerary; but it appears to me that, in a narrative, the principal end of which is the progress of physical knowledge, every other consideration ought to be subservient to those of instruction and utility. By isolating facts, travellers, whose labours are in every other respect valuable, have given currency to many false ideas of the pretended contrasts which Nature offers in Africa, in New Holland, and on the ridge of the Cordilleras. The great geological phenomena are subject to regular laws, as well as the forms of plants and animals. The ties which unite these phenomena, the relations which exist between the varied forms of organized beings, are discovered only when we have acquired the habit of viewing the globe as a great whole; and when we consider in the same point of view the composition of rocks, the causes which alter them, and the productions of the soil, in the most distant regions.

Having treated of the volcanic substances of the isle of Teneriffe, there now remains to be solved a question intimately connected with the preceding investigation. Does the archipelago of the Canary Islands contain any rocks of primitive or secondary formation; or is there any production observed, that has not been modified by fire? This interesting problem has been considered by the naturalists of Lord Macartney's expedition, and by those who accompanied captain Baudin in his voyage to the Austral regions. Their opinions are in direct opposition to each other; and the contradiction is the more striking, as the question does not refer to one of those geological reveries which we are accustomed to call systems, but to a positive fact.

Doctor Gillan imagined that he observed, between Laguna and the port of Orotava, in very deep ravines, beds of primitive rocks. This, however, is a mistake. What Dr. Gillan calls somewhat vaguely, mountains of hard ferruginous clay, are nothing but an alluvium which we find at the foot of every volcano. Strata of clay accompany basalts, as tufas accompany modern lavas. Neither M. Cordier nor myself observed in any part of Teneriffe a primitive rock, either in its natural place, or thrown out by the mouth of the Peak; and the absence of these rocks characterizes almost every island of small extent that has an unextinguished volcano. We know nothing positive of the mountains of

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the Azores; but it is certain, that the island of Bourbon as well as Teneriffe, exhibits only a heap of lavas and basalts. No volcanic rock rears its head, either on the Gros Morne, or on the volcano of Bourbon, or on the colossal pyramid of Cimandef, which is perhaps more elevated than the Peak of the Canary Islands.

Bory St. Vincent nevertheless asserted, that lavas including fragments of granite have been found on the elevated plain of Retama; and M. Broussonnet informed me, that on a hill above Guimar, fragments of mica-slate, containing beautiful plates of specular iron, had been found. I can affirm nothing respecting the accuracy of this latter statement, which it would be so much the more important to verify, as M. Poli, of Naples, is in possession of a fragment of rock thrown out by Vesuvius,* which I found to be a real mica-slate. Every thing that tends to enlighten us with respect to the site of the volcanic fire, and the position of rocks subject to its action, is highly interesting to geology.

It is possible, that at the Peak of Teneriffe, the fragments of primitive rocks thrown out by the mouth of the volcano may be less rare than they at present appear to be, and may be heaped together in some ravine, not yet visited by travellers. In fact, at Vesuvius, these same fragments are met with only in one single place, at the Fossa Grande, where they are hidden under a thick layer of ashes. If this ravine had not long ago attracted the attention of naturalists, when masses of granular limestone, and other primitive rocks, were laid bare by the rains, we might have thought them as rare at Vesuvius, as they are, at least in appearance, at the Peak of Teneriffe.

* In the valuable collection of Dr. Thomson, who resided at Naples till 1805, is a fragment of lava enclosing a real granite, which is composed of reddish feldspar with a pearly lustre like adularia, quartz, mica, hornblende, and, what is very remarkable, lazulite. But in general the masses of known primitive rocks, (I mean those which perfectly resemble our granites, our gneiss, and our mica-slates) are very rare in lavas; the substances we commonly denote by the name of granite, thrown out by Vesuvius, are mixtures of nepheline, mica, and pyroxene. We are ignorant whether these mixtures constitute rocks *sui generis* placed under granite, and consequently of more ancient date; or simply form either intermediate strata or veins, in the interior of the primitive mountains, the tops of which appear at the surface of the globe.

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With respect to the fragments of granite, gneiss, and mica-slate, found on the shores of Santa Cruz and Orotava, they were probably brought in ships as ballast. They no more belong to the soil where they lie, than the feldsparry lavas of Etna, seen in the pavements of Hamburgh and other towns of the north. The naturalist is exposed to a thousand errors, if he lose sight of the changes, produced on the surface of the globe by the intercourse between nations. We might be led to say, that man, when expatriating himself, is desirous that everything should change country with him. Not only plants, insects, and different species of small quadrupeds, follow him across the ocean; his active industry covers the shores with rocks, which he has torn from the soil in distant climes.

Though it be certain, that no scientific observer has hitherto found at Teneriffe primitive strata, or even those trappean and ambiguous porphyries, which constitute the bases of Etna, and of several volcanoes of the Andes, we must not conclude from this isolated fact, that the whole archipelago of the Canaries is the production of submarine fires. The island of Gomera contains mountains of granite and mica-slate; and it is, undoubtedly, in these very ancient rocks, that we must seek there, as well as on all other parts of the globe, the centre of the volcanic action. Amphibole, sometimes pure and forming intermediate strata, at other times mixed with granite, as in the basanites or basalts of the ancients, may, of itself, furnish all the iron contained in the black and stony lavas. This quantity amounts in the basalt of the modern mineralogists only to 0·20, while in amphibole it exceeds 0·30.

From several well-informed persons, to whom I addressed myself, I learned that there are calcareous formations in the Great Canary, Forteventura, and Lancerota.* I was not able to determine the nature of this secondary rock; but it appears certain, that the island of Teneriffe is altogether destitute of it; and that in its alluvial lands it exhibits only clayey calcareous tufa, alternating with volcanic breccia, said to contain, (near the village of La Rambla, at Calderas, and near Candelaria,) plants, imprints of fishes,

* At Lancerota calcareous stone is burned to lime with a fire made of the alhulaga, a new species of thorny and arborescent Sonchus.

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buccinites, and other fossil marine productions. M. Cordier brought away some of this tufa, which resembles that in the environs of Naples and Rome, and contains fragments of reeds. At the Salvages, which islands La Perouse took at a distance for masses of scoriæ, even fibrous gypsum is found.

I had seen, while herborizing between the port of Orotava and the garden of La Paz, heaps of grayish calcareous stones, of an imperfect conchoidal fracture, and analogous to that of Mount Jura and the Apennines. I was informed that these stones were extracted from a quarry near Rambla; and that there were similar quarries near Realejo, and the mountain of Roxas, above Adexa. This information led me into an error. As the coasts of Portugal consist of basalts covering calcareous rocks containing shells, I imagined that a trappean formation, like that of the Vicentin in Lombardy, and of Harutsh in Africa, might have extended from the banks of the Tagus and Cape St. Vincent as far as the Canary Islands; and that the basalts of the Peak might perhaps conceal a secondary calcareous stone. These conjectures exposed me to severe animadversions from M. G. A. de Luc, who is of opinion that every volcanic island is only an accumulation of lavas and scoriæ. M. de Luc declares it is impossible that real lava should contain fragments of vegetable substances. Our collections, however, contain pieces of trunks of palm-trees, enclosed and penetrated by the very liquid lava of the isle of Bourbon.

Though Teneriffe belongs to a group of islands of considerable extent, the Peak exhibits nevertheless all the characteristics of a mountain rising on a solitary islet. The lead finds no bottom at a little distance from the ports of Santa Cruz, Orotava, and Garachico: in this respect it is like St. Helena. The ocean, as well as the continents, has its mountains and its plains; and, if we except the Andes, volcanic cones are formed everywhere in the lower regions of the globe.

As the Peak rises amid a system of basalts and old lava, and as the whole part which is visible above the surface of the waters exhibits burnt substances, it has been supposed that this immense pyramid is the effect of a progressive accumulation of lavas; or that it contains in its centre a nucleus of primitive rocks. Both of these suppositions

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appear to me ill-founded. I think there is as little probability that mountains of granite, gneiss, or primitive calcareous stone have existed where we now see the tops of the Peak, of Vesuvius, and of Etna, as in the plains where almost in our own time has been formed the volcano of Jorullo, which is more than a third of the height of Vesuvius. On examining the circumstances which accompanied the formation of the new island, called Sabrina, in the archipelago of the Azores;* on carefully reading the minute and simple narrative, given by the Jesuit Bourguignon of the slow appearance of the islet of the little Kameni, near Santorino; we find that these extraordinary eruptions are generally preceded by a swelling of the softened crust of the globe. Rocks appear above the waters before the flames force their way, or lava issue from the crater: we must distinguish between the nucleus raised up, and the mass of lavas and scoriæ, which successively increases its dimensions.

It is true that from all existing records of revolutions of this kind, the perpendicular height of the stony nucleus appears never to have exceeded one hundred and fifty or two hundred toises; even taking into the account the depth of the sea, the bottom of which had been lifted up: but when considering the great effects of nature, and the intensity of its forces, the bulk of the masses must not deter the geologist in his speculations. Every thing indicates that the physical changes of which tradition has preserved the remembrance, exhibit but a feeble image of those gigantic catastrophes which have given mountains their present form, changed the positions of the rocky strata,

* At Sabrina island, near St. Michael's, the crater opened at the foot of a solid rock, of almost a cubical form. This rock, surmounted by a small elevated plain perfectly level, is more than two hundred toises in breadth. Its formation was anterior to that of the crater, into which, a few days after its opening, the sea made an irruption. At Kameni, the smoke was not even visible till twenty-six days after the appearance of the upheaved rocks. *Phil. Trans.* vol. xxvi, p. 69 and 200, vol. xxvii., p. 353. All these phenomena, on which Mr. Hawkins collected very valuable observations during his abode at Santorino, are unfavourable to the idea commonly entertained of the origin of volcanic mountains. They are usually ascribed to a progressive accumulation of liquified matter, and the diffusion of lavas issuing from a central mouth.

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and buried sea-shells on the summits of the higher Alps. Doubtless, in those remote times which preceded the existence of the human race, the raised crust of the globe produced those domes of trappean porphyry, those hills of isolated basalt on vast elevated plains, those solid nuclei which are clothed in the modern lavas of the Peak, of Etna, and of Cotopaxi. The volcanic revolutions have succeeded each other after long intervals, and at very different periods: of this we see the vestiges in the transition mountains, in the secondary strata, and in those of alluvium. Volcanoes of earlier date than the sandstone and calcareous rocks have been for ages extinguished; those which are yet in activity are in general surrounded only with breccias and modern tufas; but nothing hinders us from admitting, that the archipelago of the Canaries may exhibit some real rocks of secondary formation, if we recollect that subterranean fires have been there rekindled in the midst of a system of basalts and very ancient lavas.

We seek in vain in the Periplus of Hanno or of Scylax for the first written notions on the eruptions of the Peak of Teneriffe. Those navigators sailed timidly along the coast, anchoring every evening in some bay, and had no knowledge of a volcano distant fifty-six leagues from the coast of Africa. Hanno nevertheless relates, that he saw torrents of light, which seemed to fall on the sea; that every night the coast was covered with fire; and that the great mountain, called the *Car of the Gods*, appeared to throw up sheets of flame, which rose even to the clouds. But this mountain, situated northward of the island of the Gorilli, formed the western extremity of the Atlas chain; and it is also very uncertain whether the flames seen by Hanno were the effect of some volcanic eruption, or whether they must be attributed to the custom, common to many nations, of setting fire to the forests and dry grass of the savannahs. In our own days similar doubts were entertained by the naturalists, who, in the voyage of d'Entrecasteaux, saw the island of Amsterdam covered with a thick smoke. On the coast of the Caracas, trains of reddish fire, fed by the burning grass, appeared to me, for several nights, under the delusive semblance of a current of lava, descending from the mountains, and dividing itself into several branches.

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Though the narratives of Hanno and Scylax, in the state in which they have reached us, contain no passage which we can reasonably apply to the Canary Islands, it is very probable that the Carthaginians, and even the Phœnicians, had some knowledge of the Peak of Teneriffe. In the time of Plato and Aristotle, vague notions of it had reached the Greeks, who considered the whole of the coast of Africa, beyond the Pillars of Hercules, as thrown into disorder by the fire of volcanoes. The Abode of the Blessed, which was sought first in the north, beyond the Riphæan mountains, among the Hyperboreans, and next to the south of Cyrenaica, was supposed to be situated in regions that were considered to be westward, being the direction in which the world known to the ancients terminated. The name of Fortunate Islands was long in as vague signification, as that of El Dorado among the conquerors of America. Happiness was thought to reside at the end of the earth, as we seek for the most exquisite enjoyments of the mind in an ideal world beyond the limits of reality.

We must not be surprised that, previous to the time of Aristotle, we find no accurate notion respecting the Canary Islands and the volcanoes they contain, among the Greek geographers. The only nation whose navigations extended toward the west and the north, the Carthaginians, were interested in throwing a veil of mystery over those distant regions. While the senate of Carthage was averse to any partial emigration, it pointed out those islands as a place of refuge in times of trouble and public misfortune; they were to the Carthaginians what the free soil of America has become to Europeans amidst their religious and civil dissensions.

The Canaries were not better known to the Romans till eighty-four years before the reign of Augustus. A private individual was desirous of executing the project, which wise foresight had dictated to the senate of Carthage. Sertorius, conquered by Sylla, and weary of the din of war, looked out for a safe and peaceable retreat. He chose the Fortunate Islands, of which a delightful picture had been

* The idea of the happiness, the great civilization, and the riches of the inhabitants of the north, was common to the Greeks, to the people of India, and to the Mexicans.

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drawn for him on the shores of Bætica. He carefully combined the notions he acquired from travellers; but in the little that has been transmitted to us of those notions, and in the more minute descriptions of Sebosus and Juba, there is no mention of volcanoes or volcanic eruptions. Scarcely can we recognise the isle of Teneriffe, and the snows with which the summit of the Peak is covered in winter, in the name of *Nivaria*, given to one of the Fortunate Islands. Hence we might conclude, that the volcano at that time threw out no flames, if it were allowable so to interpret the silence of a few authors, whom we know only by short fragments or dry nomenclatures. The naturalist vainly seeks in history for documents of the first eruptions of the Peak; he nowhere finds any but in the language of the Guanches, in which the word Echeyde denotes, at the same time, hell and the volcano of Teneriffe.

Of all the written testimonies, the oldest I have found in relation to the activity of this volcano dates from the beginning of the sixteenth century. It is contained in the narrative of the voyage of Aloysio Cadamusto, who landed at the Canaries in 1505. This traveller was witness of no eruptions, but he positively affirms that, like Etna, this mountain burns without interruption, and that the fire has been seen by christians held in slavery by the Guanches of Teneriffe. The Peak, therefore, was not at that time in the state of repose in which we find it at present; for it is certain that no navigator or inhabitant of Teneriffe has seen issue from the mouth of the Peak, I will not say flames, but even any smoke visible at a distance. It would be well, perhaps, were the funnel of the Caldera to open anew; the lateral eruptions would thereby be rendered less violent, and the whole group of islands would be less endangered by earthquakes.

The eruptions of the Peak have been very rare for two centuries past, and these long intervals appear to characterize volcanoes highly elevated. The smallest one of all, Stromboli, is almost always burning. At Vesuvius, the eruptions are rarer than formerly, though still more frequent than those of Etna and the Peak of Teneriffe. The colossal summits of the Andes, Cotopaxi and Tungurahua, scarcely have an eruption once in a century. We may say, that

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in active volcanoes the frequency of the eruptions is in the inverse ratio of the height and the mass. The Peak also had seemed extinguished during ninety-two years, when, in 1798, it made its last eruption by a lateral opening formed in the mountain of Chahorra. In this interval Vesuvius had sixteen eruptions.

The whole of the mountainous part of the kingdom of Quito may be considered as an immense volcano, occupying more than seven hundred square leagues of surface, and throwing out flames by different cones, known under the particular denominations of Cotopaxi, Tungurahua, and Pichincha. The group of the Canary Islands is situated on the same sort of submarine volcano. The fire makes its way sometimes by one and sometimes by another of these islands. Teneriffe alone contains in its centre an immense pyramid terminating in a crater, and throwing out, from one century to another, lava by its flanks. In the other islands, the different eruptions have taken place in various parts; and we nowhere find those isolated mountains to which the volcanic effects are confined. The basaltic crust, formed by ancient volcanoes, seems everywhere undermined; and the currents of lava, seen at Lancerota and Palma, remind us, by every geological affinity, of the eruption which took place in 1301 at the island of Ischia, amid the tufas of Epomeo.

The exclusively lateral action of the peak of Teneriffe is a geological phenomenon, the more remarkable as it contributes to make the mountains which are backed by the principal volcano appear isolated. It is true, that in Etna and Vesuvius the great flowings of lava do not proceed from the crater itself, and that the abundance of melted matter is generally in the inverse ratio of the height of the opening whence the lava is ejected. But at Vesuvius and Etna a lateral eruption constantly terminates by flashes of flame and by ashes issuing from the crater, that is, from the summit of the mountain. At the Peak this phenomenon has not been witnessed for ages: and yet recently, in the eruption of 1798, the crater remained quite inactive. Its bottom did not sink in; while at Vesuvius, as M. von Buch has observed, the greater or less depth of the

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crater is an infallible indication of the proximity of a new eruption.

I might terminate these geological sketches by enquiring into the nature of the combustible which has fed for so many thousands of years the fire of the peak of Teneriffe;—I might examine whether it be sodium or potassium, the metallic basis of some earth, carburet of hydrogen, or pure sulphur combined with iron, that burns in the volcano;—but wishing to limit myself to what may be the object of direct observation, I shall not take upon me to solve a problem for which we have not yet sufficient data. We know not whether we may conclude, from the enormous quantity of sulphur contained in the crater of the Peak, that it is this substance which keeps up the heat of the volcano; or whether the fire, fed by some combustible of an unknown nature, effects merely the sublimation of the sulphur. What we learn from observation is, that in craters which are still burning, sulphur is very rare; while all the ancient volcanoes end in becoming sulphur-pits. We might presume that, in the former, the sulphur is combined with oxygen, while, in the latter, it is merely sublimated; for nothing hitherto authorises us to admit that it is formed in the interior of volcanoes, like ammonia and the neutral salts. When we were yet unacquainted with sulphur, except as disseminated in the muriatiferous gypsum and in the Alpine limestone, we were almost forced to the belief, that in every part of the globe the volcanic fire acted on rocks of secondary formation; but recent observations have proved that sulphur exists in great abundance in those primitive rocks which so many phenomena indicate as the centre of the volcanic action. Near Alausi, at the back of the Andes of Quito, I found an immense quantity in a bed of quartz, which formed a layer of mica-slate. This fact is the more important, as it is in strict conformity with the conclusions deduced from the observation of those fragments of ancient rocks which are thrown out intact by volcanoes.

We have just considered the island of Teneriffe merely in a geological point of view; we have seen the Peak towering amid fractured strata of basalt and mandelstein; let us examine how these fused masses have been gradually

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adorned with vegetable clothing, what is the distribution of plants on the steep declivity of the volcano, and what is the aspect or physiognomy of vegetation in the Canary Islands.

In the northern part of the temperate zone, the cryptogamous plants are the first that cover the stony crust of the globe. The lichens and mosses, that develope their foliage beneath the snows, are succeeded by gramina and other phanerogamous plants. This order of vegetation differs on the borders of the torrid zone, and in the countries between the tropics. We there find, it is true, whatever some travellers may have asserted, not only on the mountains, but also in humid and shady places, almost on a level with the sea, Funaria, Dicranum, and Bryum; and these genera, among their numerous species, exhibit several which are common to Lapland, to the Peak of Teneriffe, and to the Blue Mountains of Jamaica.* Nevertheless, in general, it is not by mosses and lichens that vegetation in the countries near the tropics begins. In the Canary Islands, as well as in Guinea, and on the rocky coasts of Peru, the first vegetation which prepares the soil are the succulent plants; the leaves of which, provided with an infinite number of orifices† and cutaneous vessels, deprive the ambient air of the water it holds in solution. Fixed in the crevices of volcanic rocks, they form, as it were, that first layer of vegetable earth with which the currents of lithoid lava are clothed. Wherever these lavas are scorified, and where they have a shining surface, as in the basaltic mounds to the north of Lancerota, the development of vegetation is extremely slow, and many ages may pass away before shrubs can take root. It is only when lavas are covered with tufa and ashes, that the volcanic islands, losing that appearance of nudity which marks their origin, bedeck themselves in rich and brilliant vegetation.

* This extraordinary fact was first observed by M. Swarz. It was confirmed by M. Willdenouw when he careful examined our herbals, especially the collection of cryptogamous plants, which we gathered on the tops of the Andes, in a region of the world where organic life is totally different from that of the old world.

† The *pores corticaux* of M. Decandolle, discovered by Gleichen, and figured by Hedwig.

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In its present state, the island of Teneriffe, the *Chinerfe** of the Guanches, exhibits five zones of plants, which we may distinguish by the names—region of vines, region of laurels, region of pines, region of the retama, and region of grasses. These zones are ranged in stages, one above another, and occupy, on the steep declivity of the Peak, a perpendicular height of 1750 toises; while fifteen degrees farther north, on the Pyrenees, snow descends to thirteen or fourteen hundred toises of absolute elevation. If the plants of Teneriffe do not reach the summit of the volcano, it is not because the perpetual snow and the cold of the surrounding atmosphere mark limits which they cannot pass; it is the scorified lava of the Malpays, the powdered and barren pumice-stone of the Piton, which impede the migration of plants towards the brink of the crater.

The first zone, that of the vines, extends from the sea-shore to two or three hundred toises of height; it is that which is most inhabited, and the only part carefully cultivated. In the low regions, at the port of Orotava, and wherever the winds have free access, the centigrade thermometer stands in winter, in the months of January and February, at noon, between fifteen and seventeen degrees; and the greatest heats of summer do not exceed twenty-five or twenty-six degrees. The mean temperature of the coasts of Teneriffe appears at least to rise to twenty-one degrees (16·8° Reaumur); and the climate in those parts keeps at the medium between the climate of Naples and that of the torrid zone.

The region of the vines exhibits, among its vegetable productions, eight kinds of arborescent Euphorbia; Mesembrianthema, which are multiplied from the Cape of Good Hope to the Peloponnesus; the Cacalia Kleinia, the Dracæna, and other plants, which in their naked and tortuous trunks, in their succulent leaves, and their tint of blueish green, exhibit distinctive marks of the vegetation of Africa. It is in this zone that the date-tree, the plantain, the sugar-cane, the Indian fig, the Arum Colocasia, the root of which furnishes a nutritive fecula, the olive-tree, the fruit trees of Europe, the vine, and corn are cultivated. Corn is reaped from the end of March to the beginning of

* Of Chinerfe the Europeans have formed, by corruption, Tchineriffe and Teneriffe.

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May; and the culture of the bread-fruit tree of Otaheite, that of the cinnamon tree of the Moluccas, the coffee-tree of Arabia, and the cacao-tree of America, have been tried with success. On several points of the coast the country assumes the character of a tropical landscape; and we perceive that the region of the palms extends beyond the limits of the torrid zone. The chamærops and the date-tree flourish in the fertile plains of Murviedro, on the coasts of Genoa, and in Provence, near Antibes, between the thirty-ninth and forty-fourth degrees of latitude; a few trees of the latter species, planted within the walls of the city of Rome, resist even the cold of 2·5° below freezing point. But if the south of Europe as yet only partially shares the gifts lavished by nature on the zone of palms, the island of Teneriffe, situated on the parallel of Egypt, southern Persia, and Florida, is adorned with the greater part of the vegetable forms which add to the majesty of the landscape in the regions near the equator.

On reviewing the different tribes of indigenous plants, we regret not finding trees with small pinnated leaves, and arborescent gramina. No species of the numerous family of the sensitive-plants has migrated as far as the archipelago of the Canary Islands, while on both continents they have been seen in the thirty-eighth and fortieth degrees of latitude. On a more careful examination of the plants of the islands of Lancerota and Forteventura, which are nearest the coast of Morocco, we may perhaps find a few mimosas among many other plants of the African flora.

The second zone, that of the laurels, comprises the woody part of Teneriffe: this is the region of the springs, which gush forth amidst turf always verdant, and never parched with drought. Lofty forests crown the hills leading to the volcano, and in them are found four species of laurel,* an oak nearly resembling the Quercus Turneri† of the mountains of Thibet, the Visnea mocanera, the Myrica Faya of the Azores, a native olive (Olea excelsa), which is the largest tree of this zone, two species of Sideroxylon, the leaves of which are

* Laurus indica, L. fœtens, L. nobilis, and L. Til. With these trees are mingled the Ardisia excelsa, Rhamnus glandulosus, Erica arborea, and E. texo.

† Quercus canariensis, Broussonnet.

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extremely beautiful, the Arbutus callicarpa, and other evergreen trees of the family of myrtles. Bindweeds, and an ivy very different from that of Europe (Hedera canariensis) entwine the trunks of the laurels; at their feet vegetate a numberless quantity of ferns,* of which three species† alone descend as low as the region of the vines. The soil, covered with mosses and tender grass, is enriched with the flowers of the Campanula aurea, the Chrysanthemum pinnatifidum, the Mentha canariensis, and several bushy species of Hypericum.‡ Plantations of wild and grafted chesnut-trees form a broad border round the region of the springs, which is the greenest and most agreeable of the whole.

In the third zone (beginning at nine hundred toises of absolute height), the last groups of Arbutus, of Myrica Faya, and of that beautiful heath known to the natives by the name of Texo, appear. This zone, four hundred toises in breadth, is entirely filled by a vast forest of pines, among which mingles the Juniperus cedro of Broussonnet. The leaves of these pines are very long and stiff, and they sprout sometimes by pairs, but oftener by threes in one sheath. Having had no opportunity of examining the fructification, we cannot say whether this species, which has the appearance of the Scotch fir, is really different from the eighteen species of pines with which we are already acquainted in Europe. M. Decandolle is of opinion that the pine of Teneriffe is equally distinct from the Pinus atlantica of the neighbouring mountains of Mogador, and from the pine of Aleppo,§ which belongs to the basin of the Mediterranean, and does not appear to have passed the Pillars of Hercules. We met with these last pines on the slope of the Peak, near twelve hundred toises above the level of the

* Woodwardia radicans, Asplenium palmatum, A. canariensis, A. latifolium, Nothalæna subcordata, Trichomanes canariensis, T. speciosum, and Davallia canariensis.

† Two Acrostichums and the Ophyoglossum lusitanicum.

‡ Hypericum canariense, H. floribundum, and H. glandulosum.

§ Pinus halepensis. M. Decandolle observes, that this species, which is not found in Portugal, but grows on the Mediterranean shores of France, Spain, and Italy, in Asia Minor, and in Barbary, would be better named Pinus mediterranea. It composes the principal part of the pine-forests of the south-east of France, where Gouan and Gerard have confounded it with the Pinus sylvestris. It comprehends the Pinus halepensis, Mill., Lamb., and Desfont., and the Pinus maritima, Lamb.

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sea. In the Cordilleras of New Spain, under the torrid zone, the Mexican pines extend to the height of two thousand toises. Notwithstanding the similarity of structure existing between the different species of the same genus of plants, each of them requires a certain degree of temperature and rarity in the ambient air to attain its due growth. If in temperate climates, and wherever snow falls, the uniform heat of the soil be somewhat above the mean heat of the atmosphere, it is probable that at the height of Portillo the roots of the pines draw their nourishment from a soil, in which, at a certain depth, the thermometer rises at most to nine or ten degrees.

The fourth and fifth zones, the regions of the retama and the gramina, occupy heights equal to the most inaccessible summits of the Pyrenees. It is the sterile part of the island where heaps of pumice-stone, obsidian, and broken lava, form impediments to vegetation. We have already spoken of those flowery tufts of alpine broom (Spartium nubigenum), which form oases amidst a vast desert of ashes. Two herbaceous plants, the Scrophularia glabrata and the Viola cheiranthifolia, advance even to the Malpays. Above a turf scorched by the heat of an African sun, an arid soil is overspread by the Cladonia paschalis. Towards the summit of the Peak the Urceolarea and other plants of the family of the lichens, help to work the decomposition of the scorified matter. By this unceasing action of organic force the empire of Flora is extended over islands ravaged by volcanoes.

On surveying the different zones of the vegetation of Teneriffe, we perceive that the whole island may be considered as a forest of laurels, arbutus, and pines, containing in its centre a naked and rocky soil, unfit either for pasturage or cultivation. M. Broussonnet observes, that the archipelago of the Canaries may be divided into two groups of islands; the first comprising Lancerota and Forteventura, the second Teneriffe, Canary, Gomera, Ferro, and Palma. The appearance of the vegetation essentially differs in these two groups. The eastern islands, Lancerota and Forteventura, consist of extensive plains and mountains of little elevation; they have very few springs, and bear the appearance, still more than the other islands, of having been separated from the continent. The winds blow in the same direction, and at the same periods: the Euphorbia mauri-

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tanica, the Atropa frutescens, and the arborescent Sonchus, vegetate there in the loose sands, and afford, as in Africa, food for camels. The western group of the Canaries presents a more elevated soil, is more woody, and is watered by a greater number of springs.

Though the whole archipelago contains several plants found also in Portugal,* in Spain, at the Azores, and in the north-west of Africa, yet a great number of species, and even some genera, are peculiar to Teneriffe, to Porto Santo, and to Madeira. Such are the Mocanera, the Plocama, the Bosea, the Canarina, the Drusa, and the Pittosporum. A form which may be called northern, that of the cruciform plant,† is much rarer in the Canaries than in Spain and in Greece. Still farther to the south, in the equinoctial regions of both continents, where the mean temperature of the air rises above twenty-two degrees, the cruciform plants are scarcely ever to be seen.

A question highly interesting to the history of the progressive marks of organization on the globe has been very warmly discussed in our own times, that of ascertaining whether the polymorphous plants are more common in the volcanic islands. The vegetation of Teneriffe is unfavourable to the hypothesis that nature in new countries is but little subject to permanent forms. M. Broussonnet, who resided so long at the Canaries, asserts that the variable plants are not more common there than in the south of Europe. May

* M. Willdenow and myself found, among the plants of the peak of Teneriffe, the beautiful Satyrium diphyllum (Orchis cordata, Willd.), which Mr. Link discovered in Portugal. The Canaries have, in common with the Flora of the Azores, not the Dicksonia culcita, the only arborescent heath found at the thirty-ninth degree of latitude, but the Asplenium palmatum, and the Myrica Faya. This last tree is met with in Portugal, in a wild state. Count Hoffmansegg has seen very old trunks of it; but it was doubtful whether it was indigenous, or imported into that part of our continent. In reflecting on the migrations of plants, and on the geological possibility, that lands sunk in the ocean may have heretofore united Portugal, the Azores, the Canaries, and the chain of Atlas, we conceive, that the existence of the Myrica Faya in western Europe is a phenomenon at least as striking as that of the pine of Aleppo would be at the Azores.

† Among the small number of cruciform species contained in the Flora of Teneriffe, we shall here mention Cheiranthus longifolius, l'Hérit.; Ch. fructescens, Vent.; Ch. scoparius, Brouss.; Erysimum bicorne, Aiton; Crambe strigosa, and C. lævigata, Brouss.

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it not to be presumed, that the polymorphous species, which are so abundant in the isle of Bourbon, are assignable to the nature of the soil and climate rather than to the newness of the vegetation?

Before we take leave of the old world to pass into the new, I must advert to a subject which is of general interest, because it belongs to the history of man, and to those fatal revolutions which have swept off whole tribes from the face of the earth. We inquire at the isle of Cuba, at St. Domingo, and in Jamaica, where is the abode of the primitive inhabitants of those countries? We ask at Teneriffe what is become of the Guanches, whose mummies alone, buried in caverns, have escaped destruction? In the fifteenth century almost all mercantile nations, especially the Spaniards and the Portuguese, sought for slaves at the Canary Islands, as in later times they have been sought on the coast of Guinea.* The Christian religion, which in its origin was so highly favourable to the liberty of mankind, served afterwards as a pretext to the cupidity of Europeans. Every individual, made prisoner before he received the rite of baptism, became a slave. At that period no attempt had yet been made to prove that the blacks were an intermediate race between man and animals. The swarthy Guanche and the African negro were simultaneously sold in the market of Seville, without a question whether slavery should be the doom only of men with black skins and woolly hair.

The archipelago of the Canaries was divided into several small states hostile to each other, and in many instances the same island was subject to two independent princes. The trading nations, influenced by the hideous policy still exercised on the coast of Africa, kept up intestine warfare. One Guanche then became the property of another, who sold him to the Europeans; several, who preferred death to slavery, killed themselves and their children. The population of the Canaries had considerably suffered by the slave trade, by the depredations of pirates, and especially by a long period of carnage, when Alonzo de Lugo completed the conquest of the Guanches. The surviving remnants of the

* The Spanish historians speak of expeditions made by the Huguenots of Rochelle to carry off Guanche slaves. I have some doubt respecting these expeditions, which are said to have taken place subsequently to the year 1530.

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race perished mostly in 1494, in the terrible pestilence called the *modorra*, which was attributed to the quantity of dead bodies left exposed in the open air by the Spaniards after the battle of La Laguna. The nation of the Guanches was extinct at the beginning of the seventeenth century; a few old men only were found at Candelaria and Guimar.

It is, however, consoling to find that the whites have not always disdained to intermarry with the natives; but the Canarians of the present day, whom the Spaniards familiarly call Isleños (Islanders), have very powerful motives for denying this mixture. In a long series of generations time effaces the characteristic marks of a race; and as the descendants of the Andalusians settled at Teneriffe are themselves of dark complexion, we may conceive that intermarriages cannot have produced a perceptible change in the colour of the whites. It is very certain that no native of pure race exists in the whole island. It is true that a few Canarian families boast of their relationship to the last shepherd-king of Guimar, but these pretensions do not rest on very solid foundations, and are only renewed from time to time when some Canarian of more dusky hue than his countrymen is prompted to solicit a commission in the service of the king of Spain.

A short time after the discovery of America, when Spain was at the highest pinnacle of her glory, the gentle character of the Guanches was the fashionable topic, as we in our times laud the Arcadian innocence of the inhabitants of Otaheite. In both these pictures the colouring is more vivid than true. When nations, wearied with mental enjoyments, behold nothing in the refinement of manners but the germ of depravity, they are pleased with the idea, that in some distant region, in the first dawn of civilization, infant society enjoys pure and perpetual felicity. To this sentiment Tacitus owed a part of his success, when he sketched for the Romans, subjects of the Cæsars, a picture of the manners of the inhabitants of Germany. The same sentiment gives an ineffable charm to the narrative of those travellers who, at the close of the last century, visited the South Sea Islands.

The inhabitants of those islands, too much vaunted (and previously anthropophagi), resemble, under more than one point of view, the Guanches of Teneriffe. Both nations

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were under the yoke of feudal government. Among the Guanches, this institution, which facilitates and renders a state of warfare perpetual, was sanctioned by religion. The priests declared to the people: "The great Spirit, Achaman, created first the nobles, the *achimenceys*, to whom he distributed all the goats that exist on the face of the earth. After the nobles, Achaman created the plebeians, *achicaxnas*. This younger race had the boldness to petition also for goats; but the supreme Spirit answered, that this race was destined to serve the nobles, and that they had need of no property." This tradition was made, no doubt, to please the rich vassals of the shepherd-kings. The *faycan*, or high priest, also exercised the right of conferring nobility; and the law of the Guanches expressed that every achimencey who degraded himself by milking a goat with his own hands, lost his claim to nobility. This law does not remind us of the simplicity of the Homeric age. We are astonished to see the useful labours of agriculture, and of pastoral life, exposed to contempt at the very dawn of civilization.

The Guanches, famed for their tall stature, were the Patagonians of the old world. Historians exaggerated the muscular strength of the Guanches, as, previous to the voyage of Bougainville and Cordoba, colossal proportions were attributed to the tribe that inhabited the southern extremity of America. I never saw Guanche mummies but in the cabinets of Europe. At the time I visited the Canaries they were very scarce; a considerable number, however, might be found if miners were employed to open the sepulchral caverns which are cut in the rock on the eastern slope of the Peak, between Arico and Guimar. These mummies are in a state of desiccation so singular, that whole bodies, with their integuments, frequently do not weigh above six or seven pounds; or a third less than the skeleton of an individual of the same size, recently stripped of the muscular flesh. The conformation of the skull has some slight resemblance to that of the white race of the ancient Egyptians; and the incisive teeth of the Guanches are blunted, like those of the mummies found on the banks of the Nile. But this form of the teeth is the result of art; and on examining more carefully the physiognomy of the ancient Canarians, Blumenbach and other able anatomists have recognized in the cheek bones and the lower jaw perceptible differences from the Egyptian

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mummies. On opening those of the Guanches, remains of aromatic plants are discovered, among which the Chenopodium ambrosioïdes is constantly perceived: the bodies are often decorated with small laces, to which are hung little discs of baked earth, which appear to have served as numerical signs, and resemble the *quippoes* of the Peruvians, the Mexicans, and the Chinese.

The population of islands being in general less exposed than that of continents to the effect of migrations, we may presume that, in the time of the Carthaginians and the Greeks, the archipelago of the Canaries was inhabited by the same race of men as were found by the Norman and Spanish conquerors. The only monument that can throw any light on the origin of the Guanches is their language; but unhappily there are not above a hundred and fifty words extant, and several express the same object, according to the dialect of the different islanders. Independently of these words, which have been carefully noted, there are still some valuable fragments existing in the names of a great number of hamlets, hills, and valleys. The Guanches, like the Biscayans, the Hindoos, the Peruvians, and all primitive nations, named places after the quality of the soil, the shape of the rocks, the caverns that gave them shelter, and the nature of the tree that overshadowed the springs.*

* It has been long imagined, that the language of the Guanches had no analogy with the living tongues; but since the travels of Hornemann, and the ingenious researches of Marsden and Venturi, have drawn the attention of the learned to the Berbers, who, like the Sarmatic tribes, occupy an immense extent of country in the north of Africa, we find that several Guanche words have common roots with words of the Chilha and Gebali dialects. We shall cite, for instance, the words:

Heaven, *in Guanche* —	Tigo;	*in Berberic,* —	Tigot.
Milk . . .	Aho;	. . .	Acho.
Barley . . .	Temasen;	. . .	Tomzeen.
Basket . . .	Carianas;	. . .	Carian.
Water . . .	Aenum;	. . .	Anan.

I doubt whether this analogy is a proof of a common origin; but it is an indication of the ancient connexion between the Guanches and Berbers, a tribe of mountaineers, in which the ancient Numidians, Getuli, and Garamanti are confounded, and who extend themselves from the eastern extremity of Atlas by Harutsh and Fezzan, as far as the oasis of Siwah and Augela. The natives of the Canary Islands called themselves Guanches, from *guan*, man; as the Tonguese call themselves *bye*, and *tongui*, which have the same signification as *guan*. Besides, the nations

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The greater attention we direct to the study of languages in a philosophical point of view, the more we must observe that no one of them is entirely distinct. The language of the Guanches would appear still less so, had we any data respecting its mechanism and grammatical construction; two elements more important than the form of words, and the identity of sounds. It is the same with certain idioms, as with those organized beings that seem to shrink from all classification in the series of natural families. Their isolated state is merely apparent; for it ceases when, on embracing a greater number of objects, we come to discover the intermediate links. Those learned enquirers who trace Egyptians wherever there are mummies, hieroglyphics, or pyramids, will imagine perhaps that the race of Typhon was united to the Guanches by the Berbers, real Atlantes, to whom belong the Tibboes and the Tuarycks of the desert: but this hypothesis is supported by no analogy between the Berberic and Coptic languages, which are justly considered as remnants of the ancient Egyptian.

The people who have succeeded the Guanches are descended from the Spaniards, and in a more remote degree from the Normans. Though these two races have been exposed during three centuries past to the same climate, the latter is distinguished by the fairer complexion. The descendants of the Normans inhabit the valley of Teganana, between Punta de Naga and Punta de Hidalgo. The names of Grandville and Dampierre are still pretty common in this district. The Canarians are a moral, sober, and religious people, of a less industrious character at home than in foreign countries. A roving and enterprising disposition leads these islanders, like the Biscayans and Catalonians, to the Philippines, to the Ladrone Islands, to America, and wherever there are Spanish settlements, from Chile and La Plata to New Mexico. To them we are in a great measure indebted for the progress of agriculture in those colonies. The whole archipelago does not contain 160,030 inhabitants, and the *Isleños* are perhaps more numerous in the new continent than in their own country.

who speak the Berberic language are not all of the same race; and the description which Scylax gives, in his Periplus, of the inhabitants of Cerne, a shepherd people of tall stature and long hair, reminds us of the features which characterize the Canarian Guanches.

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Chapter III.

Passage from Teneriffe to South America.—The Island of Tobago.—Arrival at Cumana.

We left the road of Santa Cruz on the 25th of June, and directed our course towards South America. We soon lost sight of the Canary Islands, the lofty mountains of which were covered with a reddish vapour. The Peak alone appeared from time to time, as at intervals the wind dispersed the clouds that enveloped the Piton. We felt, for the first time, how strong are the impressions left on the mind from the aspect of those countries situated on the limits of the torrid zone, where nature appears at once so rich, so various, and so majestic. Our stay at Teneriffe had been very short, and yet we withdrew from the island as if it had long been our home.

Our passage from Santa Cruz to Cumana, the most eastern part of the New Continent, was very fine. We cut the tropic of Cancer on the 27th; and though the Pizarro was not a very fast sailer, we made, in twenty days, the nine hundred leagues, which separate the coast of Africa from that of the New Continent. We passed fifty leagues west of Cape Bojador, Cape Blanco, and the Cape Verd islands. A few land birds, which had been driven to sea by the impetuosity of the wind followed us for several days.

The latitude diminished rapidly, from the parallel of Madeira to the tropic. When we reached the zone where the trade-winds are constant, we crossed the ocean from east to west, on a calm sea, which the Spanish sailors call the Ladies' Gulf, *el Golfo de las Damas*. In proportion as we advanced towards the west, we found the trade-winds fix to eastward.

These winds, the most generally adopted theory of which is explained in a celebrated treatise of Halley,* are a phe-

* The existence of an upper current of air, which blows constantly from the equator to the poles, and of a lower current, which blows from the poles to the equator, had already been admitted, as M. Arago has shown, by Hooke. The ideas of the celebrated English naturalist are developed in a Discourse on Earthquakes, published in 1686. "I think

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nomenon much more complicated than most persons admit. In the Atlantic Ocean, the longitude, as well as the declination of the sun, influences the direction and limits of the trade-winds. In the direction of the New Continent, in both hemispheres, these limits extend beyond the tropics eight or nine degrees; while in the vicinity of Africa, the variable winds prevail far beyond the parallel of 28 or 27 degrees. It is to be regretted, on account of the progress of meteorology and navigation, that the changes of the currents of the equinoctial atmosphere in the Pacific are much less known than the variation of these same currents in a sea that is narrower, and influenced by the proximity of the coasts of Guinea and Brazil. The difference with which the strata of air flow back from the two poles towards the equator cannot be the same in every degree of longitude, that is to say, on points of the globe where the continents are of very different breadths, and where they stretch away more or less towards the poles.

It is known, that in the passage from Santa Cruz to Cumana, as in that from Acapulco to the Philippine Islands, seamen are scarcely ever under the necessity of working their sails. We pass those latitudes as if we were descending a river, and we might deem it no hazardous undertaking if we made the voyage in an open boat. Farther west, on the coast of St. Martha and in the Gulf of Mexico, the trade-wind blows impetuously, and renders the sea very stormy.*

The wind fell gradually the farther we receded from the African coast: it was sometimes smooth water for several hours, and these short calms were regularly interrupted by electrical phenomena. Black thick clouds, marked by strong outlines, rose on the east, and it seemed as if a squall would have forced us to hand our topsails; but the breeze fresh-

(adds he) that several phenomena, which are presented by the atmosphere and the ocean, especially the winds, may be explained by the polar currents."—Hooke's Posthumous Works, p. 364.

* The Spanish sailors call the rough trade-winds at Carthagena in the West Indias *los brisotes de Santa Martha;* and in the Gulf of Mexico, *las brizas pardas.* These latter winds are accompanied with a gray and cloudy sky.

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ened anew, there fell a few large drops of rain, and the storm dispersed without our hearing any thunder. Meanwhile it was curious to observe the effect of several black, isolated, and very low clouds, which passed the zenith. We felt the force of the wind augment or diminish progressively, according as small bodies of vesicular vapour approached or receded, while the electrometers, furnished with a long metallic rod and lighted match, showed no change of electric tension in the lower strata of the air. It is by help of these squalls, which alternate with dead calms, that the passage from the Canary Islands to the Antilles, or southern coast of America, is made in the months of June and July.

Some Spanish navigators have lately proposed going to the West Indies and the coasts of Terra-Firma by a course different from that which was taken by Columbus. They advise, instead of steering directly to the south in search of the trade-winds, to change both latitude and longitude, in a diagonal line from Cape St. Vincent to America. This method, which shortens the way, cutting the tropic nearly twenty degrees west of the point where it is commonly cut by pilots, was several times successfully adopted by Admiral Gravina. That able commander, who fell at the battle of Trafalgar, arrived in 1802 at St. Domingo, by the oblique passage, several days before the French fleet, though orders of the court of Madrid would have forced him to enter Ferrol with his squadron, and stop there some time.

This new system of navigation shortens the passage from Cadiz to Cumana one-twentieth; but as the tropic is attained only at the longitude of forty degrees, the chance of meeting with contrary winds, which blow sometimes from the south, and at other times from the south-west, is more unfavourable. In the old system, the disadvantage of making a longer passage is compensated by the certainty of catching the trade-winds in a shorter space of time, and keeping them the greater part of the passage. At the time of my abode in the Spanish colonies, I witnessed the arrival of several merchant-ships, which from the fear of privateers had chosen the oblique course, and had had a very short passage.

Nothing can equal the beauty and mildness of the climate

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of the equinoctial region on the ocean. While the trade wind blew strongly, the thermometer kept at 23 or 24 degrees in the day, and at 22 or 22·5 degrees during the night. The charm of the lovely climates bordering on the equator, can be fully enjoyed only by those who have undertaken the voyage from Acapulco or the coasts of Chile to Europe in a very rough season. What a contrast between the tempestuous seas of the northern latitudes and the regions where the tranquillity of nature is never disturbed! If the return from Mexico or South America to the coasts of Spain were as expeditious and as agreeable as the passage from the old to the new continent, the number of Europeans settled in the colonies would be much less considerable than it is at present. To the sea which surrounds the Azores and the Bermuda Islands, and which is traversed in returning to Europe by the high latitudes, the Spaniards have given the singular name of *Golfo de las Yeguas* (the Mares' Gulf). Colonists who are not accustomed to the sea, and who have led solitary lives in the forests of Guiana, the savannahs of the Caracas, or the Cordilleras of Peru, dread the vicinity of the Bermudas more than the inhabitants of Lima fear at present the passage round Cape Horn.

To the north of the Cape Verd Islands we met with great masses of floating seaweeds. They were the tropic grape, (Fucus natans), which grows on submarine rocks, only from the equator to the fortieth degree of north and south latitude. These weeds seem to indicate the existence of currents in this place, as well as to south-west of the banks of Newfoundland. We must not confound the latitudes abounding in scattered weeds with those banks of marine plants, which Columbus compares to extensive meadows, the sight of which dismayed the crew of the Santa Maria in the forty-second degree of longitude. I am convinced, from the comparison of a great number of journals, that in the basin of the Northern Atlantic there exist two banks of weeds very different from each other. The most extensive is a little west of the meridian of Fayal, one of the Azores, between the twenty-fifth and thirty-sixth degrees of latitude.* The temperature of the Atlantic in those

* It would appear that Phœnician vessels came "in thirty days' sail, with an easterly wind," to the *weedy sea*, which the Portuguese and

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latitudes is from sixteen to twenty degrees, and the north winds, which sometimes rage there very tempestuously, drive floating isles of seaweed into the low latitudes as far as the parallels of twenty-four and even twenty degrees. Vessels returning to Europe, either from Monte Video or the Cape of Good Hope, cross these banks of Fucus, which the Spanish pilots consider as at an equal distance from the Antilles and Canaries; and they serve the less instructed mariner to rectify his longitude. The second bank of Fucus is but little known; it occupies a much smaller space, in the twenty-second and twenty-sixth degrees of latitude, eighty leagues west of the meridian of the Bahama Islands. It is found on the passage from the Caiques to the Bermudas.

Though a species of seaweed* has been seen with stems eight hundred feet long, the growth of these marine cryptogamia being extremely rapid, it is nevertheless certain, that in the latitudes we have just described, the Fuci, far from being fixed to the bottom, float in separate masses on the surface of the water. In this state, the vegetation can scarcely last longer than it would in the branch of a tree torn from its trunk; and in order to explain how moving masses are found for ages in the same position, we must admit that they owe their origin to submarine rocks, which, lying at forty or sixty fathoms' depth, continually supply what has been carried away by the equinoctial currents. This current bears the tropic grape into the high latitudes, toward the coasts of Norway and France; and it is not the Gulf-stream, as some mariners think, which accumulates the Fucus to the south of the Azores.

The causes that unroot these weeds at depths where it is generally thought the sea is but slightly agitated, are not sufficiently known. We learn only, from the observations

Spaniards call *mar de zargasso*. I have shown, in another place ("Views of Nature," Bohn's edition, p. 46), that the passage of Aristotle, *De Mirabil.* (ed. Duval, p. 1157), can scarcely be applied to the coasts of Africa, like an analogous passage of the Periplus of Scylax. Supposing that this sea, full of weeds, which impeded the course of the Phœnician vessels, was the *mar de sargasso*, we need not admit that the ancients navigated the Atlantic beyond thirty degrees of west longitude from the meridian of Paris.

* The *baudreux* of the Falkland Islands; Fucus giganteus, Forster; Laminaria pyrifera Lamour.

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of M. Lamouroux, that if the fucus adhere to the rocks with the greatest firmness before its fructification, it separates with great facility after that period, or during the season which suspends its vegetation like that of the terrestrial plants. The fish and mollusca which gnaw the stems of the seaweeds no doubt contribute also to detach them from their roots.

From the twenty-second degree of latitude, we found the surface of the sea covered with flying-fish,* which threw themselves up into the air, twelve, fifteen, or eighteen feet, and fell down on the deck. I do not hesitate to speak on a subject of which voyagers discourse as frequently as of dolphins, sharks, sea-sickness, and the phosphorescence of the ocean. None of these topics can fail to afford interesting observations to naturalists, provided they make them their particular study. Nature is an inexhaustible source of investigation, and in proportion as the domain of science is extended, she presents herself to those who know how to interrogate her, under forms which they have never yet examined.

I have named the flying-fish, in order to direct the attention of naturalists to the enormous size of their natatory bladder, which, in an animal of 6·4 inches, is 3·6 inches long, 0·9 of an inch broad, and contains three cubic inches and a half of air. As this bladder occupies more than half the size of the fish, it is probable that it contributes to its lightness. We may assert that this reservoir of air is more fitted for flying than swimming; for the experiments made by M. Provenzal and myself have proved, that, even in the species which are provided with this organ, it is not indispensably necessary for the ascending movement to the surface of the water. In a young flying-fish, 5·8 inches long, each of the pectoral fins, which serve as wings, presented a surface to the air of $3\frac{7}{16}$ square inches. We observed, that the nine branches of nerves, which go to the twelve rays of these fins, are almost three times the size of the nerves that belong to the ventral fins. When the former of these nerves are excited by galvanic electricity, the rays which support the membrane of the pectoral fin extend with five times the force with which the other fins move when

* Exocœtus volitans.

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galvanised by the same metals. Thus, the fish is capable of throwing itself horizontally the distance of twenty feet before retouching the water with the extremity of its fins. This motion has been aptly compared to that of a flat stone, which, thrown horizontally, bounds one or two feet above the water. Notwithstanding the extreme rapidity of this motion, it is certain, that the animal beats the air during the leap; that is, it alternately extends and closes its pectoral fins. The same motion has been observed in the flying scorpion of the rivers of Japan: they also contain a large air-bladder, with which the great part of the scorpions that have not the faculty of flying are unprovided. The flying-fish, like almost all animals which have gills, enjoy the power of equal respiration for a long time, both in water and in air, by the same organs; that is, by extracting the oxygen from the atmosphere as well as from the water in which it is dissolved. They pass a great part of their life in the air; but if they escape from the sea to avoid the voracity of the Dorado, they meet in the air the Frigate-bird, the Albatross, and others, which seize them in their flight. Thus, on the banks of the Orinoco, herds of the Cabiai, which rush from the water to escape the crocodile, become the prey of the jaguar, which awaits their arrival.

I doubt, however, whether the flying-fish spring out of the water merely to escape the pursuit of their enemies. Like swallows, they move by thousands in a right line, and in a direction constantly opposite to that of the waves. In our own climates, on the brink of a river, illumined by the rays of the sun, we often see solitary fish fearlessly bound above the surface as if they felt pleasure in breathing the air. Why should not these gambols be more frequent with the flying-fish, which from the strength of their pectoral fins, and the smallness of their specific gravity, can so easily support themselves in the air? I invite naturalists to examine whether other flying-fish, for instance the Exocætus exiliens, the Trigla volitans, and the T. hirundo, have as capacious an air-bladder as the flying-fish of the tropics. This last follows the heated waters of the Gulf-stream when they flow northward. The cabin-boys amuse themselves with cutting off a part of the pectoral fins, and assert, that these wings grow

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again; which seems to me not unlikely, from facts observed in other families of fishes.

At the time I left Paris, experiments made at Jamaica by Dr. Brodbelt, on the air contained in the natatory bladder of the sword-fish, had led some naturalists to think, that within the tropics, in sea-fish, that organ must be filled with pure oxygen gas. Full of this idea, I was surprised at finding in the air-bladder of the flying-fish only 0·04 of oxygen to 0·94 of azote and 0·02 of carbonic acid. The proportion of this last gas, measured by the absorption of lime-water in graduated tubes, appeared more uniform than that of the oxygen, of which some individuals yielded almost double the quantity. From the curious phenomena observed by MM. Biot, Configliachi, and Delaroche, we might suppose, that the sword-fish dissected by Dr. Brodbelt had inhabited the lower strata of the ocean, where some fish* have as much as 0·92 of oxygen in the air-bladder.

On the 3rd and 4th of July, we crossed that part of the Atlantic where the charts indicate the bank of the Maal-stroom; and towards night we altered our course to avoid the danger, the existence of which is, however, as doubtful as that of the isles Fonseco and St. Anne. It would have been perhaps as prudent to have continued our course. The old charts are filled with rocks, some of which really exist, though most of them are merely the offspring of those optical illusions which are more frequent at sea than in inland places. As we approached the supposed Maal-stroom, we observed no other motion in the waters than the effect of a current which bore to the north-west, and which hindered us from diminishing our latitude as much as we wished. The force of this current augments as we approach the new continent; it is modified by the configuration of the coasts of Brazil and Guiana, and not by the waters of the Orinoco and the Amazon, as some have supposed.

From the time we entered the torrid zone, we were never weary of admiring, at night, the beauty of the southern sky, which, as we advanced to the south, opened new constellations to our view. We feel an indescribable sensation when, on approaching the equator, and particularly on passing from

* Trigla cucullus.

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one hemisphere to the other, we see those stars, which we have contemplated from our infancy, progressively sink, and finally disappear. Nothing awakens in the traveller a livelier remembrance of the immense distance by which he is separated from his country, than the aspect of an unknown firmament. The grouping of the stars of the first magnitude, some scattered nebulæ, rivalling in splendour the milky way, and tracts of space remarkable for their extreme blackness, give a peculiar physiognomy to the southern sky. This sight fills with admiration even those who, uninstructed in the several branches of physical science, feel the same emotion of delight in the contemplation of the heavenly vault, as in the view of a beautiful landscape, or a majestic site. A traveller needs not to be a botanist, to recognize the torrid zone by the mere aspect of its vegetation. Without having acquired any notions of astronomy, without any acquaintance with the celestial charts of Flamstead and De la Caille, he feels he is not in Europe, when he sees the immense constellation of the Ship, or the phosphorescent Clouds of Magellan, arise on the horizon. The heavens and the earth,—everything in the equinoctial regions, presents an exotic character.

The lower regions of the air were loaded with vapours for some days. We saw distinctly for the first time the Southern Cross only on the night of the 4th of July, in the sixteenth degree of latitude. It was strongly inclined, and appeared from time to time between the clouds, the centre of which, furrowed by uncondensed lightnings, reflected a silvery light. If a traveller may be permitted to speak of his personal emotions, I shall add, that on that night I experienced the realization of one of the dreams of my early youth.

When we begin to fix our eyes on geographical maps, and to read the narratives of navigators, we feel for certain countries and climates a sort of predilection, which we know not how to account for at a more advanced period of life. These impressions, however, exercise a considerable influence over our determinations; and from a sort of instinct we endeavour to connect ourselves with objects on which the mind has long been fixed as by a secret charm. At a period when I studied the heavens, not with the intention of devoting myself to astronomy, but only to acquire a knowledge of

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the stars, I was disturbed by a feeling unknown to those who are devoted to sedentary life. It was painful to me to renounce the hope of beholding the beautiful constellations near the south pole. Impatient to rove in the equinoctial regions, I could not raise my eyes to the starry firmament without thinking of the Southern Cross, and recalling the sublime passage of Dante, which the most celebrated commentators have applied to that constellation:—

Io mi volsi a man' destra e posi mente
All' altro polo, e vidi quattro stelle
Non viste mai fuorch' alla prima gente.

Goder parea lo ciel di lor fiammelle;
O settentrional vedovo sito
Poichè privato sei di mirar quelle!

The pleasure we felt on discovering the Southern Cross was warmly shared by those of the crew who had visited the colonies. In the solitude of the seas we hail a star as a friend, from whom we have long been separated. The Portuguese and the Spaniards are peculiarly susceptible of this feeling; a religious sentiment attaches them to a constellation, the form of which recalls the sign of the faith planted by their ancestors in the deserts of the New World.

The two great stars which mark the summit and the foot of the Cross having nearly the same right ascension, it follows that the constellation is almost perpendicular at the moment when it passes the meridian. This circumstance is known to the people of every nation situated beyond the tropics, or in the southern hemisphere. It has been observed at what hour of the night, in different seasons, the Cross is erect or inclined. It is a timepiece which advances very regularly nearly four minutes a-day, and no other group of stars affords to the naked eye an observation of time so easily made. How often have we heard our guides exclaim in the savannahs of Venezuela, or in the desert extending from Lima to Truxillo, "Midnight is past, the Cross begins to bend!" How often those words reminded us of that affecting scene, where Paul and Virginia, seated near the source of the river of Lataniers, conversed together for the last time, and where the old man, at the sight of the Southern Cross, warns them that it is time to separate.

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The last days of our passage were not so felicitous as the mildness of the climate and the calmness of the ocean had led us to hope. The dangers of the sea did not disturb us, but the germs of a malignant fever became manifest on board our vessel as we drew near the Antilles. Between decks the ship was excessively hot, and very much crowded. From the time we passed the tropic, the thermometer was at thirty-four or thirty-six degrees. Two sailors, several passengers, and, what is remarkable enough, two negroes from the coast of Guinea, and a mulatto child, were attacked with a disorder which appeared to be epidemic. The symptoms were not equally alarming in all the cases; nevertheless, several persons, and especially the most robust, fell into delirium after the second day. No fumigation was made. A Gallician surgeon, ignorant and phlegmatic, ordered bleedings, because he attributed the fever to what he called heat and corruption of the blood. There was not an ounce of bark on board; for we had omitted to take any with us, under the impression that this salutary production of Peru could not fail to be found on board a Spanish vessel.

On the 8th of July, a sailor, who was near expiring, recovered his health from a circumstance worthy of being mentioned. His hammock was so hung, that there was not ten inches between his face and the deck. It was impossible to administer the sacrament in this situation; for, agreeably to the custom on board Spanish vessels, the viaticum must be carried by the light of tapers, and followed by the whole crew. The patient was removed into an airy place near the hatchway, where a small square berth had been formed with sail-cloth. Here he was to remain till he died, which was an event expected every moment; but passing from an atmosphere heated, stagnant, and filled with miasma, into fresher and purer air, which was renewed every instant, he gradually revived from his lethargic state. His recovery dated from the day when he quitted the middle deck; and as it often happens in medicine that the same facts are cited in support of systems diametrically opposite, this recovery confirmed our doctor in his idea of the inflammation of the blood, and the necessity of bleeding, evacuating, and all the asthenic remedies. We soon felt the fatal effects of this treatment.

For several days the pilot's reckoning differed 1° 12′ in

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longitude from that of my time. This difference was owing less to the general current, which I have called the current of rotation, than to that particular movement, which, drawing the waters toward the north-west, from the coast of Brazil to the Antilles, shortens the passage from Cayenne to Guadaloupe.* On the 12th of July, I thought I might foretell our seeing land next day before sunrise. We were then, according to my observations, in latitude 10° 46′, and west longitude 60° 54′. A few series of lunar distances confirmed the chronometrical result; but we were surer of the position of the vessel, than of that of the land to which we were directing our course, and which was so differently marked in the French, Spanish, and English charts. The longitudes deduced from the accurate observations of Messrs. Churruca, Fidalgo, and Noguera, were not then published.

The pilots trusted more to the log than the timekeeper; they smiled at the prediction of so speedily making land, and thought themselves two or three days' sail from the coast. It was therefore with great pleasure, that on the 13th, about six in the morning, I learned that very high land was seen from the mast-head, though not clearly, as it was surrounded with a thick fog. The wind blew hard, and the sea was very rough. Large drops of rain fell at intervals, and every indication menaced tempestuous weather. The captain of the Pizarro intended to pass through the channel which separates the islands of Tobago and Trinidad; and knowing that our sloop was very slow in tacking, he was afraid of falling to leeward towards the south, and approaching the Boca del Drago. We were in fact surer of our longitude than of our latitude, having had no observation at noon since the 11th. Double altitudes which I took in the morning, after Douwes's method, placed us in 11° 6′ 50″, consequently 15′ north of our reckoning. Though the result clearly proved that the high land on the horizon was not Trinidad, but Tobago, yet

* In the Atlantic Ocean there is a space where the water is constantly milky, though the sea is very deep. This curious phenomenon exists in the parallel of the island of Dominica, very near the 57th degree of longitude. May there not be in this place some sunken volcanic islet, more easterly still than Barbadoes?

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the captain continued to steer NNW, in search of this latter island.

An observation of the meridian altitude of the sun fully confirmed the latitude obtained by Douwes's method. No more doubt remained as to the position of the vessel, with respect to the island, and we resolved to double Cape North (Tobago) to pass between that island and Grenada, and steer towards a port in Margareta.

The island of Tobago presents a very picturesque aspect. It is merely a heap of rocks carefully cultivated. The dazzling whiteness of the stone forms an agreeable contrast to the verdure of some scattered tufts of trees. Cylindric and very lofty cactuses crown the top of the mountains, and give a peculiar physiognomy to this tropical landscape. The sight of the trees alone is sufficient to remind the navigator that he has reached an American coast; for these cactuses are as exclusively peculiar to the New World, as the heaths are to the Old.

We crossed the shoal which joins Tobago to the island of Grenada. The colour of the sea presented no visible change; but the centigrade thermometer, plunged into the water to the depth of some inches, rose only to 23°; while farther at sea eastward on the same parallel, and equally near the surface, it kept at 25·6°. Notwithstanding the currents, the cooling of the water indicated the existence of the shoal, which is noted in only a very few charts. The wind slackened after sunset, and the clouds disappeared as the moon reached the zenith. The number of falling stars was very considerable on this and the following nights; they appeared less frequent towards the north than the south over Terra Firma, which we began to coast. This position seems to prove the influence of local causes on meteors, the nature of which is not yet sufficiently known to us.

On the 14th at sunrise, we were in sight of the Boca del Drago. We distinguished Chacachacarreo, the most westerly of the islands situated between Cape Paria and the north-west cape of Trinidad. When we were five leagues distant from the coast, we felt, near Punta de la Boca, the effect of a particular current which carried the ship south-

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ward. The motion of the waters which flow through the Boca del Drago, and the action of the tides, occasion an eddy. We cast the lead, and found from thirty-six to forty-three fathoms on a bottom of very fine green clay. According to the rules established by Dampier, we ought not to have expected so little depth near a coast formed by very high and perpendicular mountains. We continued to heave the lead till we reached Cabo de tres Puntas* and we every where found shallow water, apparently indicating the prolongation of the ancient coast. In these latitudes the temperature of the sea was from twenty-three to twenty-four degrees, consequently from 1·5 to two degrees lower than in the open ocean, beyond the edge of the bank.

The Cabo de tres Puntas is, according to my observations, in 65° 4′ 5″ longitude. It seemed to us the more elevated, as the clouds concealed the view of its indented top. The aspect of the mountains of Paria, their colour, and especially their generally rounded forms, made us suspect that the coast was granitic; but we afterwards recognized how delusive, even to those who have passed their lives in scaling mountains, are impressions respecting the nature of rocks seen at a distance.

A dead calm, which lasted several hours, permitted us to determine with exactness the intensity of the magnetic forces opposite the Cabo de tres Puntas. This intensity was greater than in the open sea, to the east of the island of Tobago, in the ratio of from 237 to 229. During the calm the current drew us on rapidly to the west. Its velocity was three miles an hour, and it increased as we approached the meridian of Testigos, a heap of rocks which rises up amidst the waters. At the setting of the moon, the sky was covered with clouds, the wind freshened anew, and the rain descended in one of those torrents peculiar to the torrid zone.

The malady which had broken out on board the Pizarro had made rapid progress, from the time when we approached the coasts of Terra Firma; but having then almost reached the end of our voyage we flattered ourselves that all who were sick would be restored to health, as soon as we could

* Cape Three Points, the name given to it by Columbus.

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land them at the island of St. Margareta, or the port of Cumana, places remarkable for their great salubrity.

This hope was unfortunately not realised. The youngest of the passengers attacked with the malignant fever fell a victim to the disease. He was an Asturian, nineteen years of age, the only son of a poor widow. Several circumstances rendered the death of this young man affecting. His countenance bore the expression of sensibility and great mildness of disposition. He had embarked against his own inclination; and his mother, whom he had hoped to assist by the produce of his efforts, had made a sacrifice of her affection in the hope of securing the fortune of her son, by sending him to the colonies to a rich relation, who resided at the island of Cuba. The unfortunate young man expired on the third day of his illness, having fallen from the beginning into a lethargic state interrupted only by fits of delirium. The yellow fever, or black vomit, at Vera Cruz, scarcely carries off the sick with so alarming a rapidity. Another Asturian, still younger, did not leave for one moment the bed of his dying friend; and, what is very remarkable, did not contract the disorder.

We were assembled on the deck, absorbed in melancholy reflections. It was no longer doubtful, that the fever which raged on board had assumed within the last few days a fatal aspect. Our eyes were fixed on a hilly and desert coast on which the moon, from time to time, shed her light athwart the clouds. The sea, gently agitated, emitted a feeble phosphoric light. Nothing was heard but the monotonous cry of a few large sea-birds, flying towards the shore. A profound calm reigned over these solitary regions, but this calm of nature was in discordance with the painful feelings by which we were oppressed. About eight o'clock the dead man's knell was slowly tolled. At this lugubrious sound, the sailors suspended their labours, and threw themselves on their knees to offer a momentary prayer: an affecting ceremony, which brought to our remembrance those times when the primitive christians all considered themselves as members of the same family. All were united in one common sorrow for a misfortune which was felt to be common to all. The corpse of the

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young Asturian was brought upon deck during the night, but the priest entreated that it might not be committed to the waves till after sunrise, that the last rites might be performed, according to the usage of the Romish church. There was not an individual on board, who did not deplore the death of this young man, whom we had beheld, but a few days before, full of cheerfulness and health.

Those among the passengers who had not yet felt symptoms of the disease, resolved to leave the vessel at the first place where she might touch, and await the arrival of another packet, to pursue their course to the island of Cuba and to Mexico. They considered the between-decks of the ship as infected; and though it was by no means clear to me that the fever was contagious, I thought it most prudent to land at Cumana. I wished not to visit New Spain, till I had made some sojourn on the coasts of Venezuela and Paria; a few of the productions of which had been examined by the unfortunate Loefling. We were anxious to behold in their native site, the beautiful plants which Bose and Bredemeyer had collected during their journey to the continent, and which adorn the conservatories of Schoenbrunn and Vienna. It would have been painful to have touched at Cumana, or at Guayra, without visiting the interior of a country so little frequented by naturalists.

The resolution we formed during the night of the 14th of July, had a happy influence on the direction of our travels; for instead of a few weeks, we remained a whole year in this part of the continent. Had not the fever broken out on board the Pizarro, we should never have reached the Orinoco, the Cassiquiare, or even the limits of the Portuguese possessions on the Rio Negro. To this direction given to our travels we were perhaps also indebted for the good health we enjoyed during so long an abode in the equinoctial regions.

It is well known, that Europeans, during the first months after their arrival under the scorching sky of the tropics, are exposed to the greatest dangers. They consider themselves to be safe, when they have passed the rainy season in the West India islands, at Vera Cruz, or at Carthagena. This

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opinion is very general, although there are examples of persons, who, having escaped a first attack of the yellow fever, have fallen victims to the same disease in one of the following years. The facility of becoming acclimated, seems to be in the inverse ratio of the difference that exists between the mean temperature of the torrid zone, and that of the native country of the traveller, or colonist, who changes his climate; because the irritability of the organs, and their vital action, are powerfully modified by the influence of the atmospheric heat. A Prussian, a Pole, or a Swede, is more exposed on his arrival at the islands or on the continent, than a Spaniard, an Italian, or even an inhabitant of the South of France. With respect to the people of the north, the difference of the mean temperature, is from nineteen to twenty-one degrees, while to the people of southern countries it is only from nine to ten. We were fortunate enough to pass safely through the interval during which a European recently landed runs the greatest danger, in the extremely hot, but very dry climate of Cumana, a city celebrated for its salubrity.

On the morning of the 15th, when nearly on a line with the hill of St. Joseph, we were surrounded by a great quantity of floating seaweed. Its stems had those extraordinary appendages in the form of little cups and feathers, which Don Hippolyto Ruiz remarked on his return from the expedition to Chile, and which he described in a separate memoir as the generative organs of the Fucus natans. A fortunate accident allowed us the means of verifying a fact which had been but once observed by naturalists. The bundles of fucus collected by M. Bonpland were completely identical with the specimens given us by the learned authors of the Flora of Peru. On examining both with the microscope, we found that the supposed parts of fructification, the stamina and pistils, belong to a new genus, of the family of the Ceratophytæ.

The coast of Paria stretches to the west, forming a wall of rocks of no great height, with rounded tops and a waving outline. We were long without perceiving the bold coasts of the island of Margareta, where we were to stop for the purpose of ascertaining whether we could touch at Guayra. We had learned, by altitudes of the sun, taken under very favourable circumstances, how incorrect at that period were

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the most highly-esteemed marine charts. On the morning of the 15th, when the time-keeper placed us in 66° 1′ 15″ longitude, we were not yet in the meridian of Margareta island; though according to the reduced chart of the Atlantic ocean, we ought to have passed the very lofty western cape of this island, which is laid down in longitude 66° 0′. The inaccuracy with which the coasts were delineated previously to the labours of Fidalgo, Noguera, and Tiscar, and I may venture to add, before the astronomical observations I made at Cumana, might have become dangerous to navigators, were not the sea uniformly calm in those regions. The errors in latitude were still greater than those in longitude, for the coasts of New Andalusia stretch to the westward of Cape Three Points (or tres Puntas) fifteen or twenty miles more to the north, than appears in the charts published before the year 1800.

About eleven in the morning we perceived a very low islet, covered with a few sandy downs, and on which we discovered with our glasses no trace of habitation or culture. Cylindrical cactuses rose here and there in the form of candelabra. The soil, almost destitute of vegetation, seemed to have a waving motion, in consequence of the extraordinary refraction which the rays of the sun undergo in traversing the strata of air in contact with plains strongly heated. Under every zone, deserts and sandy shores appear like an agitated sea, from the effect of mirage.

The coasts, seen at a distance, are like clouds, in which each observer meets the form of the objects that occupy his imagination. Our bearings and our chronometer being at variance with the charts which we had to consult, we were lost in vain conjectures. Some took mounds of sand for Indian huts, and pointed out the place where they alleged the fort of Pampatar was situated; others saw herds of goats, which are so common in the dry valley of St. John; or descried the lofty mountains of Macanao, which seemed to them partly hidden by the clouds. The captain resolved to send a pilot on shore, and the men were preparing to get out the long-boat when we perceived two canoes sailing along the coast. We fired a gun as a signal for them, and though we had hoisted Spanish colours, they drew near with distrust. These canoes, like all those in use among the natives, were constructed of the single trunk of a tree. In

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each canoe there were eighteen Guayqueria Indians, naked to the waist, and of very tall stature. They had the appearance of great muscular strength, and the colour of their skin was something between brown and copper-colour. Seen at a distance, standing motionless, and projected on the horizon, they might have been taken for statues of bronze. We were the more struck with their appearance, as it did not correspond with the accounts given by some travellers respecting the characteristic features and extreme feebleness of the natives. We afterwards learned, without passing the limits of the province of Cumana, the great contrast existing between the physiognomy of the Guayquerias and that of the Chaymas and the Caribs.

When we were near enough to hail them in Spanish, the Indians threw aside their mistrust, and came straight on board. They informed us that the low islet near which we were at anchor was Coche, which had never been inhabited; and that Spanish vessels coming from Europe were accustomed to sail farther north, between this island and that of Margareta, to take a coasting pilot at the port of Pampatar. Our inexperience had led us into the channel to the south of Coche; and as at that period the English cruisers frequented this passage, the Indians had at first taken us for an enemy's ship. The southern passage is, in fact, highly advantageous for vessels going to Cumana and Barcelona. The water is less deep than in the northern passage, which is much narrower; but there is no risk of touching the ground, if vessels keep very close to the island of Lobos and the Moros del Tunal. The channel between Coche and Margareta is narrowed by the shoals off the north-west cape of Coche, and by the bank that surrounds La Punta de los Mangles.

The Guayquerias belong to that tribe of civilized Indians who inhabit the coasts of Margareta and the suburbs of the city of Cumana. Next to the Caribs of Spanish Guiana they are the finest race of men in Terra Firma. They enjoy several privileges, because from the earliest times of the conquest they remained faithful friends to the Castilians. The king of Spain styles them in his public acts, "his dear, noble, and loyal Guayquerias." The Indians of the two canoes we had met had left the port of Cumana during the night. They were going in search of timber to the forests of cedar (Cedrela odorata, *Linn.*), which extend from Cape

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San Jose to beyond the mouth of Rio Carupano. They gave us some fresh cocoa-nuts, and very beautifully coloured fish of the Chætodon genus. What riches to our eyes were contained in the canoes of these poor Indians! Broad spreading leaves of Vijao* covered bunches of plaintains. The scaly cuirass of an armadillo (Dasypus), the fruit of the calabash tree (Crescentia cujete), used as a cup by the natives, productions common in the cabinets of Europe, had a peculiar charm for us, because they reminded us that, having reached the torrid zone, we had attained the end to which our wishes had been so long directed.

The master of one of the canoes offered to remain on board the Pizarro as coasting pilot (practico). He was a Guayqueria of an excellent disposition, sagacious in his observations, and he had been led by intelligent curiosity to notice the productions of the sea as well as the plants of the country. By a fortunate chance, the first Indian we met on our arrival was the man whose acquaintance became the most useful to us in the course of our researches. I feel a pleasure in recording in this itinerary the name of Carlos del Pino, who, during the space of sixteen months, attended us in our course along the coasts, and into the inland country.

The captain of the corvette weighed anchor towards evening. Before we left the shoal or *placer* of Coche, I ascertained the longitude of the east cape of the island, which I found to be 66° 11′ 53″. As we steered westward, we soon came in sight of the little island of Cubagua, now entirely deserted, but formerly celebrated for its fishery of pearls. There the Spaniards, immediately after the voyages of Columbus and Ojeda, founded, under the name of New Cadiz, a town, of which there now remains no vestige. At the beginning of the sixteenth century the pearls of Cubagua were known at Seville, at Toledo, and at the great fairs of Augsburg and Bruges. New Cadiz having no water, that of the Rio Manzanares was conveyed thither from the neighbouring coast, though for some reason, I know not what, it was thought to be the cause of diseases of the eyes. The writers of that period all speak of the riches of the first planters, and the luxury they displayed. At present, downs

* Heliconia bihai.

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of shifting sand cover this uninhabited land, and the name of Cubagua is scarcely found in our charts.

Having reached these latitudes, we saw the high mountains of Cape Macanao, on the western side of the island of Margareta, which rose majestically on the horizon. If we might judge from the angles of altitude of the tops, taken at eighteen miles' distance, they appeared to be about 500 or 600 toises high. According to Berthoud's time-keeper, the longitude of Cape Macanao is 66° 47′ 5″. I speak of the rocks at the extremity of the cape, and not that strip of very low land which stretches to the west, and loses itself in a shoal. The position of Macanao and that which I have assigned to the east point of the island of Coche, differ only four seconds in time, from the results obtained by M. Fidalgo.

There being little wind, the captain preferred standing off and on till daybreak. We passed a part of the night on deck. The Guayqueria pilot conversed with us respecting the animals and plants of his country. We learned with great satisfaction that there was a few leagues from the coast a mountainous region inhabited by the Spaniards, in which the cold was sensibly felt; and that in the plains there were two species of crocodiles, very different from each other, besides, boas, electric eels, and several kinds of tigers. Though the words *bava*, *cachicamo*, and *temblador*, were entirely unknown to us, we easily guessed, from the pilot's simple description of their manners and forms, the species which the creoles distinguished by these denominations.

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Chapter IV.

First abode at Cumana.—Banks of the Manzanares.

On the 16th of July, 1799, at break of day, we beheld a verdant coast, of picturesque aspect. The mountains of New Andalusia, half-veiled by mists, bounded the horizon to the south. The city of Cumana and its castle appeared between groups of cocoa-trees. We anchored in the port about nine in the morning, forty-one days after our departure from Corunna; the sick dragged themselves on deck to enjoy the sight of a land which was to put an end to their sufferings. Our eyes were fixed on the groups of cocoa-trees which border the river: their trunks, more than sixty feet high, towered over every object in the landscape. The plain was covered with the tufts of Cassia, Caper, and those arborescent mimosas, which, like the pine of Italy, spread their branches in the form of an umbrella. The pinnated leaves of the palms were conspicuous on the azure sky, the clearness of which was unsullied by any trace of vapour. The sun was ascending rapidly toward the zenith. A dazzling light was spread through the air, along the whitish hills strewed with cylindric cactuses, and over a sea ever calm, the shores of which were peopled with alcatras,* egrets, and flamingoes. The splendour of the day, the vivid colouring of the vegetable world, the forms of the plants, the varied plumage of the birds, everything was stamped with the grand character of nature in the equinoctial regions.

The city of Cumana, the capital of New Andalusia, is a mile distant from the *embarcadero*, or the battery of the Boca, where we landed, after having passed the bar of the Manzanares. We had to cross a vast plain, called el Salado, which divides the suburb of the Guayquerias from the sea-coast. The excessive heat of the atmosphere was augmented by the reverberation of the soil, partly destitute of vegetation. The centigrade thermometer, plunged into the white sand, rose to 37·7°. In the small pools of salt water it kept at 30·5°, while the heat of the ocean, at its surface,

* A brown pelican, of the size of a swan. (Pelicanus fuscus, *Lin.*)

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is generally, in the port of Cumana, from 25·2° to 26·3°. The first plant we gathered on the continent of America was the Avicennia tomentosa,* which in this place scarcely reaches two feet in height. This shrub, together with the sesuvium, the yellow gomphrena, and the cactus, cover soil impregnated with muriate of soda; they belong to that small number of plants which live in society like the heath of Europe, and which in the torrid zone are found only on the seashore, and on the elevated plains of the Andes.† The Avicennia of Cumana is distinguished by another peculiarity not less remarkable: it furnishes an instance of a plant common to the shores of South America and the coasts of Malabar.

The Indian pilot led us across his garden, which rather resembled a copse than a piece of cultivated ground. He showed us, as a proof of the fertility of this climate, a silk-cotton tree (Bombax heptaphyllum), the trunk of which, in its fourth year, had reached nearly two feet and a half in diameter. We have observed, on the banks of the Orinoco and the river Magdalena, that the bombax, the carolinea, the ochroma, and other trees of the family of the malvaceæ, are of extremely rapid growth. I nevertheless think that there was some exaggeration in the report of the Indian respecting the age of his bombax; for under the temperate zone, in the hot and damp lands of North America, between the Mississippi and the Alleghany mountains, the trees do not exceed a foot in diameter, in ten years. Vegetation in those parts is in general but a fifth more speedy than in Europe, even taking as an example the Platanus occidentalis, the tulip tree, and the Cupressus disticha, which reach from nine to fifteen feet in diameter. On the strand of Cumana, in the garden of the Guayqueria pilot, we saw for the first time a *quama*‡ loaded with flowers, and remarkable for the extreme

* Mangle prieto.

† On the extreme rarity of the social plants in the tropics, see my "Essay on the Geog. of Plants," p. 19; and a paper by Mr. Brown on the Proteacea, "Trans. of the Lin. Soc.," vol. x., p. 1, p. 23, in which that great botanist has extended and confirmed by numerous facts my ideas on the association of plants of the same species.

‡ *Inga spuria*, which we must not confound with the common inga, Inga vera, Willd. (Mimosa Inga, Linn.). The white stamina, which, to the number of sixty or seventy, are attached to a greenish corolla, have a silky lustre,

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length and silvery splendour of its numerous stamina. We crossed the suburb of the Guayqueria Indians, the streets of which are very regular, and formed of small houses, quite new, and of a pleasing appearance. This part of the town had just been rebuilt, for the earthquake had laid Cumana in ruins eighteen months before our arrival. By a wooden bridge, we crossed the river Manzanares, which contains a few *bavas*, or crocodiles of the smaller species.

We were conducted by the captain of the Pizarro to the governor of the province, Don Vincente Emparan, to present to him the passports furnished to us by the first Secretary of State at Madrid. He received us with that frankness and unaffected dignity which have at all times characterized the natives of Biscay. Before he was appointed governor of Portobello and Cumana, Don Vincente Emparan had distinguished himself as captain of a vessel in the navy. His name recalls to mind one of the most extraordinary and distressing events recorded in the history of maritime warfare. At the time of the last rupture between Spain and England, two brothers of Señor Emperan, both of whom commanded ships in the Spanish navy, engaged with each other before the port of Cadiz, each supposing that he was attacking an enemy. A fierce battle was kept up during a whole night, and both the vessels were sunk almost simultaneously. A very small part of the crew was saved, and the two brothers had the misfortune to recognize each other a little before they expired.

The governor of Cumana expressed his great satisfaction at the resolution we had taken to remain for some time in New Andalusia, a province which at that period was but little known even by name in Europe, and which in its mountains, and on the banks of its numerous rivers, contains a great number of objects worthy of fixing the attention of naturalists. Señor Emperan showed us cottons dyed with native plants, and fine furniture made exclusively of the wood of the country. He was much interested in everything that related to natural philosophy; and asked, to our great astonishment, whether we thought, that, under the

and are terminated by a yellow anther. The flower of the *guama* is eighteen lines long. The common height of this fine tree, which prefers a moist soil, is from eight to ten toises.

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beautiful sky of the tropics, the atmosphere contained less azote (azotico) than in Spain; or whether the rapidity with which iron oxydates in those climates, were only the effect of greater humidity as indicated by the air hygrometer. The name of his native country pronounced on a distant shore would not have been more agreeable to the ear of a traveller, than those words azote, oxide of iron, and hygrometer, were to ours. Señor Emparan was a lover of science, and the public marks of consideration which he gave us during a long abode in his government, contributed greatly to procure us a favourable welcome in every part of South America.

We hired a spacious house, the situation of which was favourable for astronomical observations. We enjoyed an agreeable coolness when the breeze arose; the windows were without glass, and even without those paper panes which are often substituted for glass at Cumana. The whole of the passengers of the Pizarro left the vessel, but the recovery of those who had been attacked by the fever was very slow. We saw some who, a month after, notwithstanding the care bestowed on them by their countrymen, were still extremely weak and reduced. Hospitality, in the Spanish colonies, is such, that a European who arrives, without recommendation or pecuniary means, is almost sure of finding assistance, if he land in any port on account of sickness. The Catalonians, the Galicians, and the Biscayans, have the most frequent intercourse with America. They there form as it were three distinct corporations, which exercise a remarkable influence over the morals, the industry, and commerce of the colonies. The poorest inhabitant of Siges or Vigo is sure of being received into the house of a Catalonian or Galician pulpero,* whether he land in Chile or the Philippine Islands.

Among the sick who landed at Cumana was a negro, who fell into a state of insanity a few days after our arrival; he died in that deplorable condition, though his master, almost seventy years old, who had left Europe to settle at San Blas, at the entrance of the gulf of California, had attended him with the greatest care. I relate this fact as affording evidence that men born under the torrid zone, after having dwelt in temperate climates, sometimes feel the pernicious

* A retail dealer.

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effects of the heat of the tropics. The negro was a young man, eighteen years of age, very robust, and born on the coast of Guinea; an abode of some years on the high plain of Castile, had imparted to his organization that kind of irritability which renders the miasma of the torrid zone so dangerous to the inhabitants of the countries of the north.

The site on which Cumana is built is part of a tract of ground, very remarkable in a geological point of view. The chain of the calcareous Alps of the Brigantine and the Tataraqual stretches east and west from the summit of the Impossible to the port of Mochima and to Campanario. The sea, in times far remote, appears to have divided this chain from the rocky coasts of Araya and Maniquarez. The vast gulf of Cariaco has been caused by an irruption of the sea; and no doubt can be entertained but that the waters once covered, on the southern bank, the whole tract of land impregnated with muriate of soda, through which flows the Manzanares. The slow retreat of the waters has turned into dry ground this extensive plain, in which rises a group of small hills, composed of gypsum and calcareous breccias of very recent formation. The city of Cumana is backed by this group, which was formerly an island of the gulf of Cariaco. That part of the plain which is north of the city, is called Plaga Chica, or the Little Plain, and extends eastwards as far as Punta Delgada, where a narrow valley, covered with yellow gomphrena, still marks the point of the ancient outlet of the waters.

The hill of calcareous breccias, which we have just mentioned as having once been an island in the ancient gulf, is covered with a thick forest of cylindric cactus and opuntia. Some of these trees, thirty or forty feet high, are covered with lichens, and are divided into several branches in the form of candelabra. Near Maniquarez, at Punta Araya, we measured a cactus,* the trunk of which was four feet nine inches in circumference. A European acquainted only with the opuntia in our hot-houses is surprised to see the wood of this plant become so hard from age, that it resists for centuries both air and moisture: the Indians of Cumana therefore employ it in preference to any other for oars and door-posts.

* Tuna macho. We distinguish in the wood of the cactus the medullary prolongations, as M. Desfontaines has already observed.

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Cumana, Coro, the island of Margareta, and Curassoa, are the parts of South America that abound most in plants of the nopal family. There only, a botanist, after a long residence, could compose a monography of the genus cactus, the species of which vary not only in their flowers and fruits, but also in the form of their articulated stems, the number of costæ, and the disposition of the thorns. We shall see hereafter how these plants, which characterize a warm and singularly dry climate, like that of Egypt and California, gradually disappear in proportion as we remove from the coasts, and penetrate into the inland country.

The groups of columnar cactus and opuntia produce the same effect in the arid lands of equinoctial America as the junceæ and the hydrocharides in the marshes of our northern climes. Places in which the larger species of the strong cactus are collected in groups are considered as almost impenetrable. These places are called Tunales; and they are impervious not only to the native, who goes naked to the waist, but are formidable even to those who are fully clothed. In our solitary rambles we sometimes endeavoured to penetrate into the Tunal that crowns the summit of the castle hill, a part of which is crossed by a pathway, where we could have studied, amidst thousands of specimens, the organization of this singular plant. Sometimes night suddenly overtook us, for there is scarcely any twilight in this climate; and we then found ourselves dangerously situated, as the Cascabel, or rattle-snake, the Coral, and other vipers armed with poisonous fangs, frequent these scorched and arid haunts, to deposit their eggs in the sand.

The castle of San Antonio is built at the western extremity of the hill, but not on the most elevated point, being commanded on the east by an unfortified summit. The Tunal is considered both here and everywhere in the Spanish colonies as a very important means of military defence; and when earthen works are raised, the engineers are eager to propagate the thorny opuntia, and promote its growth, as they are careful to keep crocodiles in the ditches of fortified places. In regions where organized nature is so powerful and active, man summons as auxiliaries in his defence the carnivorous reptile, and the plant with its formidable armour of thorns.

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The castle is only thirty toises above the level of the water in the gulf of Cariaco. Standing on a naked and calcareous hill, it commands the town, and has a very picturesque effect when viewed from a vessel entering the port. It forms a bright object against the dark curtains of those mountains which raise their summits to the clouds, and of which the vaporous and bluish tint blends with the azure sky. On descending from Fort San Antonio to the south-west, we find on the slope of the same rock the ruins of the old castle of Santa Maria. This site is delightful to those who wish to enjoy at the approach of sunset the freshness of the breeze and the view of the gulf. The lofty summits of the island of Margareta are seen above the rocky coast of the isthmus of Araya, and towards the west the small islands of Caracas, Picuita, and Boracha, recall to mind the catastrophes that have overwhelmed the coasts of Terra Firma. These islets resemble fortifications, and from the effect of the mirage (while the inferior strata of the air, the ocean, and the soil, are unequally heated by the sun), their points appear raised like the extremity of the great promontories of the coast. It is pleasing, during the day, to observe these inconstant phenomena; we see, as night approaches, these stony masses which had been suspended in the air, settle down on their bases; and the luminary, whose presence vivifies organic nature, seems by the variable inflection of its rays to impress motion on the stable rock, and give an undulating movement to plains covered with arid sands.*

The town of Cumana, properly so called, occupies the ground lying between the castle of San Antonio and the small rivers of Manzanares and Santa Catalina. The Delta, formed by the bifurcation of the first of these rivers, is a fertile plain covered with Mammees, Sapotas (achras), plantains, and other plants cultivated in the gardens or charas of the Indians. The town has no remarkable edifice, and the frequency of earthquakes forbids such embellishments. It is true, that strong shocks occur less frequently in a given time at Cumana than at Quito, where we nevertheless find

* The real cause of the mirage, or the extraordinary refraction which the rays undergo when strata of air of different densities lie over each other, was guessed at by Hooke.—See his Posthumous Works, p. 472.

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sumptuous and very lofty churches. But the earthquakes of Quito are violent only in appearance, and, from the peculiar nature of the motion and of the ground, no edifice there is overthrown. At Cumana, as well as at Lima, and in several cities situated far from the mouths of burning volcanoes, it happens that the series of slight shocks is interrupted after a long course of years by great catastrophes, resembling the effects of the explosion of a mine. We shall have occasion to return to this phenomenon, for the explanation of which so many vain theories have been imagined, and which have been classified according to perpendicular and horizontal movements, shock, and oscillation.*

The suburbs of Cumana are almost as populous as the ancient town. They are three in number:—Serritos, on the road to the Plaga Chicha, where we meet with some fine tamarind trees; St. Francis, towards the south-east; and the great suburb of the Guayquerias, or Guayguerias. The name of this tribe of Indians was quite unknown before the conquest. The natives who bear that name formerly belonged to the nation of the Guaraounos, of which we find remains only in the swampy lands of the branches of the Orinoco. Old men have assured me that the language of their ancestors was a dialect of the Guaraouno; but that for a century past no native of that tribe at Cumana, or in the island of Margareta, has spoken any other language than Castilian.

The denomination Guayqueria, like the words Peru and Peruvian, owes its origin to a mere mistake. The companions of Christopher Columbus, coasting along the island of Margareta, the northern coast of which is still inhabited by the noblest portion of the Guayqueria nation,† encountered

* This classification dates from the time of Posidonius. It is the *successio* and *inclinatio* of Seneca; but the ancients had already judiciously remarked, that the nature of these shocks is too variable to permit any subjection to these imaginary laws.

† The Guayquerias of La Banda del Norte consider themselves as the most noble race, because they think they are less mixed with the Chayma Indian, and other copper-coloured races. They are distinguished from the Guayquerias of the continent by their manner of pronouncing the Spanish language, which they speak almost without separating their teeth. They show with pride to Europeans the Punta de la Galera, or Galley's Point,

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a few natives who were harpooning fish by throwing a pole tied to a cord, and terminating in an extremely sharp point. They asked them in the Hayti language their name; and the Indians, thinking that the question of the strangers related to their harpoons, which were formed of the hard and heavy wood of the Macana palm, answered *guaike, guaike*, which signifies pointed pole. A striking difference at present exists between the Guayquerias, a civilized tribe of skilful fishermen, and those savage Guaraounos of the Orinoco, who suspend their habitations on the trunks of the Moriche palm. The population of Cumana has been singularly exaggerated, but according to the most authentic registers it does not exceed 16,000 souls.

Probably the Indian suburb will by degrees extend as far as the Embarcadero; the plain, which is not yet covered with houses or huts, being more than 340 toises in length. The heat is somewhat less oppressive on the side near the sea-shore, than in the old town, where the reverberation of the calcareous soil, and the proximity of the mountain of San Antonio, raise the temperature to an excessive degree. In the suburb of the Guayquerias, the sea breezes have free access; the soil is clayey, and, for that reason, it is thought to be less exposed to violent shocks of earthquake, than the houses at the foot of the rocks and hills on the right bank of the Manzanares.

The shore near the mouth of the small river Santa Catalina is bordered with mangrove trees,* but these mangroves are not sufficiently spread to diminish the salubrity of the air of Cumana. The soil of the plain is in part destitute of vegetation, in part covered with tufts of Sesuvium portulacastrum, Gomphrena flava, G. myrtifolia, Talinum cuspidatum, T. cumanense, and Portulaca lanuginosa. Among these herbaceous plants we find at intervals the Avicennia tomentosa, the Scoparia dulcis, a frutescent mimosa with very irritable

(so called on account of the vessel of Columbus having anchored there,) and the port of Manzanillo, where they first swore to the whites in 1498, that friendship which they have never betrayed, and which has obtained for them, in court phraseology, the title of *fieles*, loyal.—See p. 144.

* Rhizophora mangle. M. Bonpland found on the Plaga Chica the Allionia incarnata, in the same place where the unfortunate Loefling had discovered this new genus of Nyctagineæ.

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leaves,* and particularly cassias, the number of which is so great in South America, that we collected, in our travels, more than thirty new species.

On leaving the Indian suburb, and ascending the river southward, we found a grove of cactus, a delightful spot, shaded by tamarinds, brazilettos, bombax, and other plants, remarkable for their leaves and flowers. The soil here is rich in pasturage, and dairy-houses built with reeds, are separated from each other by clumps of trees. The milk remains fresh, when kept, not in the calabashes† of very thick ligneous fibres, but in porous earthen vessels from Maniquarez. A prejudice prevalent in northern countries had long led me to believe, that cows, under the torrid zone, did not yield rich milk; but my abode at Cumana, and especially an excursion through the vast plains of Calabozo, covered with grasses, and herbaceous sensitive plants, convinced me that the ruminating animals of Europe become perfectly habituated to the hottest climates, provided they find water and good nourishment. Milk is excellent in the provinces of New Andalusia, Barcelona, and Venezuela; and butter is better in the plains of the equinoctial zone, than on the ridge of the Andes, where the Alpine plants, enjoying in no season a sufficiently high temperature, are less aromatic than on the Pyrenees, on the mountains of Estremadura, or of Greece. As the inhabitants of Cumana prefer the coolness of the sea breeze to the sight of vegetation, their favourite walk is the open shore. The Spaniards, who in general have no great predilection for trees, or for the warbling of birds, have transported their tastes and their habits into the colonies. In Terra Firma, Mexico, and Peru, it is rare to see a native plant a tree, merely with the view of procuring shade; and if we except the environs of the great capitals, walks bordered with trees are almost unknown in those countries. The arid plain of Cumana exhibits after violent showers an extraordinary phenomenon. The earth, when drenched with rain, and

* The Spaniards designate by the name of *dormideras* (sleeping plants), the small number of mimosas with irritable leaves. We have increased this number by three species previously unknown to botanists, namely, the Mimosa humilis of Cumana, the M. pellita of the savannahs of Calabozo, and the M. dormiens of the banks of the Apure.

† These calabashes are made from the fruit of the Crescentia cujete.

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heated again by the rays of the sun, emits that musky odour which in the torrid zone, is common to animals of very different classes, viz.: to the jaguar, the small species of tiger cat, the cabiai or thick-nosed tapir,* the galinazo vulture,† the crocodile, the viper, and the rattlesnake. The gaseous emanations, which are the vehicles of this aroma, seem to be evolved in proportion only as the mould, containing the spoils of an innumerable quantity of reptiles, worms, and insects, begins to be impregnated with water. I have seen Indian children, of the tribe of the Chaymas, draw out from the earth and eat millepedes or scolopendras‡ eighteen inches long, and seven lines broad. Whenever the soil is turned up, we are struck with the mass of organic substances, which by turns are developed, transformed, and decomposed. Nature in these climates appears more active, more fruitful, we may even say more prodigal, of life.

On this shore, and near the dairies just mentioned, we enjoy, especially at sunrise, a very beautiful prospect over an elevated group of calcareous mountains. As this group subtends an angle of three degrees only at the house where we dwelt, it long served me to compare the variations of the terrestrial refraction with the meteorological phenomena. Storms are formed in the centre of this Cordillera; and we see from afar thick clouds resolve into abundant rains, while during seven or eight months not a drop of water falls at Cumana. The Brigantine, which is the highest part of this chain, raises itself in a very picturesque manner behind Brito and Tataraqual. It takes its name from the form of a very deep valley on the northern declivity, which resembles the interior of a ship. The summit of this mountain is almost bare of vegetation, and is flat like that of Mowna-Roa, in the Sandwich Islands. It is a perpendicular wall, or, to use a more expressive term of the Spanish navigators, a table (mesa). This peculiar form, and the sym-

* Cavia capybara, Lin.; chiguire.

† Vultur aura, Lin., Zamuro, or Galinazo: the Brazilian vulture of Buffon. I cannot reconcile myself to the adoption of names, which designate, as belonging to a single country, animals common to a whole continent.

‡ Scolopendras are very common behind the castle of San Antonio, on the summit of the hill.

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metrical arrangement of a few cones which surround the Brigantine, made me at first think that this group, which is wholly calcareous, contained rocks of basaltic or trappean formation.

The governor of Cumana sent, in 1797, a band of determined men to explore this entirely desert country, and to open a direct road to New Barcelona, by the summit of the Mesa. It was reasonably expected that this way would be shorter, and less dangerous to the health of travellers, than the route taken by the couriers along the coasts; but every attempt to cross the chain of the mountains of the Brigantine was fruitless. In this part of America, as in Australia* to the west of Sydney, it is not so much the height of the mountain chains, as the form of the rocks, that presents obstacles difficult to surmount.

The longitudinal valley formed by the lofty mountains of the interior and the southern declivity of the Cerro de San Antonio, is intersected by the Rio Manzanares. This plain, the only thoroughly wooded part in the environs of Cumana, is called the Plain of the Charas,† on account of the numerous plantations which the inhabitants have begun, for some years past, along the river. A narrow path leads from the hill of San Francisco across the forest to the hospital of the Capuchins, a very agreeable country-house, which the Aragonese monks have built as a retreat for old infirm missionaries, who can no longer fulfil the duties of their ministry. As we advance to the west, the trees of the forest become more vigorous, and we meet with a few monkeys,‡ which, however, are very rare in the environs of Cumana. At the foot of the capparis, the bauhinia, and the zygophyllum with flowers of a golden yellow, there extends a carpet of Bromelia,§ akin to the B. karatas, which from the odour and coolness of its foliage attracts the rattlesnake.

* The Blue Mountains of Australia, and those of Carmarthen and Lansdowne, are not visible, in clear weather, beyond fifty miles.—Péron, Voyage aux Terres Australes, page 389. Supposing the angle of altitude half a degree, the absolute height of these mountains would be about 620 toises.

† *Chacra*, by corruption *chara*, signifies a hut or cottage surrounded by a garden. The word *ipure* has the same signification.

‡ The common *machi*, or weeping monkey.

§ Chihuchihue, of the family of the ananas.

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The waters of the Manzanares are very limpid, in quality and this river has no resemblance to the Manzanares of Madrid, which appears the more magnificent in contrast with the fine bridge by which it is crossed. It takes its source, like all the rivers of New Andalusia, in the savannahs (llanos) known by the names of the plateaux of Jonoro, Amana, and Guanipa,* and it receives, near the Indian village of San Fernando, the waters of the Rio Juanillo. It has been several times proposed to the government, but without success, to construct a dyke at the first ipure, in order to form artificial irrigations in the plain of Charas; for, notwithstanding its apparent sterility, the soil is extremely productive, wherever humidity is combined with the heat of the climate. The cultivators were gradually to refund the money advanced for the construction of the sluices. Meanwhile, pumps worked by mules, and other hydraulic but imperfect machines, have been erected, to serve till this project is carried into execution.

The banks of the Manzanares are very pleasant, and are shaded by mimosas, erythrinas, ceibas, and other trees of gigantic growth. A river, the temperature of which, in the season of the floods, descends as low as twenty-two degrees, when the air is at thirty and thirty-three degrees, is an inestimable benefit in a country where the heat is excessive during the whole year, and where it is so agreeable to bathe several times in the day. The children pass a considerable part of their lives in the water; all the inhabitants, even the women of the most opulent families, know how to swim; and in a country where man is so near the state of nature, one of the first questions asked on meeting in the morning is, whether the water is cooler than it was on the preceeding evening. One of the modes of bathing is curious. We every evening visited a family, in the suburb of the Guayquerias. In a fine moonlight night, chairs were placed in the water; the men and women were lightly clothed, as in some baths of the north of Europe; and the family and strangers, assembled in the river, passed some hours in smoking cigars, and in talking, according to the custom of

* These three eminences bear the names of *mesas*, tables. An immense plain has an almost imperceptible rise from both sides to the middle, without any appearance of mountains or hills.

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the country, of the extreme dryness of the season, of the abundant rains in the neighbouring districts, and particularly of the extravagancies of which the ladies of Cumana accuse those of the Caracas and the Havannah. The company were under no apprehensions from the bavas, or small crocodiles, which are now extremely scarce, and which approach men without attacking them. These animals are three or four feet fong. We never met with them in the Manzanares, but with a great number of dolphins (toninas), which sometimes ascend the river in the night, and frighten the bathers by spouting water.

The port of Cumana is a roadstead capable of receiving the fleets of Europe. The whole of the Gulf of Cariaco, which is about 35 miles long and 48 broad, affords excellent anchorage. The Pacific is not more calm on the shores of Peru, than the Caribbean Sea from Porto-cabello, and especially from Cape Codera to the point of Paria. The hurricanes of the West Indies are never felt in these regions. The only danger in the port of Cumana is a shoal, called Morro Roxo. There are from one to three fathoms water on this shoal, while just beyond its edges there are eighteen, thirty, and even thirty-eight. The remains of an old battery, situated north-north-east of the castle of San Antonio, and very near it, serve as a mark to avoid the bank of Morro Roxo.

The city lies at the foot of a hill destitute of verdure, and is commanded by a castle. No steeple or dome attracts from afar the eye of the traveller, but only a few trunks of tamarind, cocoa, and date trees, which rise above the houses, the roofs of which are flat. The surrounding plains, especially those on the coasts, wear a melancholy, dusty, and arid appearance, while a fresh and luxuriant vegetation marks from afar the windings of the river, which separates the city from the suburbs; the population of European and mixed race from the copper-coloured natives. The hill of fort San Antonio, solitary, white, and bare, reflects a great mass of light, and of radiant heat: it is composed of breccia, the strata of which contain numerous fossils. In the distance, towards the south, stretches a vast and gloomy curtain of mountains. These are the high calcareous Alps of New Andalusia, surmounted by sandstone, and other more

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recent formations. Majestic forests cover this Cordillera of the interior, and they are joined by a woody vale to the open clayey lands and salt marshes of the environs of Cumana. A few birds of considerable size contribute to give a peculiar character to these countries. On the sea-shore, and in the gulf, we find flocks of fishing herons, and alcatras of a very unwieldy form, which swim, like the swan, raising their wings. Nearer the habitation of man, thousands of galinazo vultures, the jackals of the winged tribe, are ever busy in disinterring the carcases of animals.* A gulf, containing hot and submarine springs, divides the secondary from the primary and schistose rocks of the peninsula of Araya. Each of these coasts is washed by a tranquil sea, of azure tint, and always gently agitated by a breeze from one quarter. A bright clear sky, with a few light clouds at sunset, reposes on the ocean, on the treeless peninsula, and on the plains of Cumana, while we see the storms accumulate and descend in fertile showers among the inland mountains. Thus on these coasts, as well as at the foot of the Andes, the earth and the sky present the extremes of clear weather and fogs, of drought and torrents of rain, of absolute nudity and never-ceasing verdure.

The analogies which we have just indicated, between the sea-coasts of New Andalusia and those of Peru, extend also to the recurrence of earthquakes, and the limits which nature seems to have prescribed to these phenomena. We have ourselves felt very violent shocks at Cumana; and we learned on the spot, the most minute circumstances that accompanied the great catastrophe of the 14th December, 1797.

It is a very generally received opinion on the coasts of Cumana, and in the island of Margareta, that the gulf of Cariaco owes its existence to a rent of the continent attended by an irruption of the sea. The remembrance of that great event was preserved among the Indians to the end of the fifteenth century; and it is related that, at the time of the third voyage of Christopher Columbus, the natives mentioned it as of very recent date. In 1530, the inhabitants were alarmed by new shocks on the coasts of Paria and Cumana. The land was inundated by the sea, and the small fort, built by James Castellon at New Toledo,† was entirely destroyed. At

* Buffon, Hist. Nat. des Oiseaux, tom. i., p. 114.

† This was the first name given to the city of Cumana.—Girolamo

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the same time an enormous opening was formed in the mountains of Cariaco, on the shores of the gulf bearing that name, when a great body of salt-water, mixed with asphaltum, issued from the micaceous schist. Earthquakes were very frequent about the end of the sixteenth century; and, according to the traditions preserved at Cumana, the sea often inundated the shores, rising from fifteen to twenty fathoms.

As no record exists at Cumana, and its archives, owing to the continual devastations of the termites, or white ants, contain no document that goes back farther than a hundred and fifty years, we are unacquainted with the precise dates of the ancient earthquakes. We only know, that, in times nearer our own, the year 1776 was at once the most fatal to the colonists, and the most remarkable for the physical history of the country. The city of Cumana was entirely destroyed, the houses were overturned in the space of a few minutes, and the shocks were hourly repeated during fourteen months. In several parts of the province the earth opened, and threw out sulphureous waters. These irruptions were very frequent in a plain extending towards Casanay, two leagues east of the town of Cariaco, and known by the name of the hollow ground (tierra hueca), because it appears entirely undermined by thermal springs. During the years 1766 and 1767, the inhabitants of Cumana encamped in their streets; and they began to rebuild their houses only when the earthquakes recurred once a-month. What was felt at Quito, immediately after the great catastrophe of February 1797, took place on these coasts. While the ground was in a state of continual oscillation, the atmosphere seemed to dissolve itself into water.

Tradition states that in the earthquake of 1766, as well as in another remarkable one in 1794, the shocks were mere horizontal oscillations; it was only on the disastrous 14th of December, 1797, that for the first time at Cumana the motion was felt by an upheaving of the ground. More than

Benzoni, Hist. del Mondo Nuovo, pp. 3, 31, and 33. James Castellon arrived at St. Domingo in 1521, after the appearance of the celebrated Bartholomew de las Casas in these countries. On attentively reading the narratives of Benzoni and Caulin, we find that the fort of Castellon was built near the mouth of the Manzanares (alla ripa del fiume de Cumana); and not, as some modern travellers have asserted, on the mountain where now stands the castle of San Antonio.

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four-fifths of the city were then entirely destroyed; and the shock, attended by a very loud subterraneous noise, resembled, as at Riobamba, the explosion of a mine at a great depth. Happily the most violent shock was preceded by a slight undulating motion, so that most of the inhabitants were enabled to escape into the streets, and a small number only perished of those who had assembled in the churches. It is a generally received opinion at Cumana, that the most destructive earthquakes are announced by very feeble oscillations, and by a hollow sound, which does not escape the observation of persons habituated to this kind of phenomenon. In those fatal moments the cries of 'misericordia! tembla! tembla!'* are everywhere heard; and it rarely happens that a false alarm is given by a native. Those who are most apprehensive attentively observe the motions of dogs, goats, and swine. The last-mentioned animals, endowed with delicate olfactory nerves, and accustomed to turn up the earth, give warning of approaching danger by their restlessness and their cries. We shall not attempt to decide, whether, being nearer the surface of the ground, they are the first to hear the subterraneous noise; or whether their organs receive the impression of some gaseous emanation which issues from the earth. We cannot deny the possibility of this latter cause. During my abode at Peru, a fact was observed in the inland country, which has an analogy with this kind of phenomenon, and which is not unfrequent. At the end of violent earthquakes, the herbs that cover the savannahs of Tucuman acquired noxious properties; an epidemic disorder broke out among the cattle, and a great number of them appeared stupified or suffocated by the deleterious vapours exhaled from the ground.

At Cumana, half an hour before the catastrophe of the 14th of December, 1797, a strong smell of sulphur was perceived near the hill of the convent of San Francisco; and on the same spot the subterraneous noise, which seemed to proceed from south-east to north-west, was loudest. At the same time flames appeared on the banks of the Manzanares, near the hospital of the Capuchins, and in the gulf of Cariaco, near Mariguitar. This last phenomenon, so extra-

* "Mercy! the earthquake! the earthquake!"—See Tschudi's Travels in Peru, p. 170.

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ordinary in a country not volcanic, is pretty frequent in the Alpine calcareous mountains near Cumanacoa, in the valley of Bordones, in the island of Margareta, and amidst the Llanos or savannahs of New Andalusia. In these savannahs, flakes of fire rising to a considerable height, are seen for hours together in the dryest places; and it is asserted, that, on examining the ground no crevice is perceptible. This fire, which resembles the springs of hydrogen, or Salse, of Modena, or what is called the will-o'-the-wisp of our marshes, does not burn the grass; because, no doubt, the column of gas, which developes itself, is mixed with azote and carbonic acid, and does not burn at its basis. The people, although less superstitious here than in Spain, call these reddish flames by the singular name of 'the soul of the tyrant Aguirre;' imagining that the spectre of Lopez Aguirre, harassed by remorse, wanders over these countries sullied by his crimes.*

The great earthquake of 1797 produced some changes in the configuration of the shoal of Morro Roxo, towards the mouth of the Rio Bordones. Similar swellings were observed at the time of the total destruction of Cumana, in 1766. At that period, the Punta Delgado, on the southern coast of the gulf of Cariaco, became perceptibly enlarged; and in the Rio Guarapiche, near the village of Maturin, a shoal was formed, no doubt by the action of the elastic fluids, which displaced and raised up the bed of the river.

In order to follow a plan conformable to the end we proposed in this work, we shall endeavour to generalize our ideas, and to comprehend in one point of view everything that relates to these phenomena, so terrific, and so difficult to explain. If it be the duty of the men of science who visit the Alps of Switzerland, or the coasts of Lapland, to extend our knowledge respecting the glaciers and the aurora borealis, it may be expected that a traveller who

* When at Cumana, or in the island of Margareta, the people pronounce the words *el tirano* (the tyrant), it is always to denote the hated Lopez d'Aguirre, who, after having taken part, in 1560, in the revolt of Fernando de Guzman against Pedro de Ursua, governor of the Omeguas and Dorado, voluntarily took the title of *traidor*, or traitor. He descended the river Amazon with his band, and reached by a communication of the rivers of Guyana the island of Margareta. The port of Paraguache still bears, in this island, the name of the Tyrant's Port.

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has journeyed through Spanish America, should have chiefly fixed his attention on volcanoes and earthquakes. Each part of the globe is an object of particular study; and when we cannot hope to penetrate the causes of natural phenomena, we ought at least to endeavour to discover their laws, and distinguish, by the comparison of numerous facts, that which is permanent and uniform from that which is variable and accidental.

The great earthquakes, which interrupt the long series of slight shocks, appear to have no regular periods at Cumana. They have taken place at intervals of eighty, a hundred, and sometimes less than thirty years; while on the coasts of Peru, for instance at Lima, a certain regularity has marked the periods of the total destruction of the city. The belief of the inhabitants in the existence of this uniformity has a happy influence on public tranquillity, and the encouragement of industry. It is generally admitted, that it requires a sufficiently long space of time for the same causes to act with the same energy; but this reasoning is just only inasmuch as the shocks are considered as a local phenomenon; and a particular focus, under each point of the globe exposed to those great catastrophes, is admitted. Whenever new edifices are raised on the ruins of the old, we hear from those who refuse to build, that the destruction of Lisbon on the first day of November, 1755, was soon followed by a second, and not less fatal convulsion, on the 31st of March, 1761.

It is a very ancient opinion,* and one that is commonly received at Cumana, Acapulco, and Lima, that a perceptible connection exists between earthquakes and the state of the atmosphere that precedes those phenomena. But from the great number of earthquakes which I have witnessed to the north and south of the equator; on the continent, and on the seas; on the coasts, and at 2500 toises height; it appears to me that the oscillations are generally very independent of the previous state of the atmosphere. This opinion is entertained by a number of intelligent residents of the Spanish colonies, whose experience extends, if not over a greater space of the globe, at least over a greater number of years,

* Arist. de Meteor. lib. ii, (ed. Duval, tom. i. p. 798). Seneca, Nat. Quæst., lib. vi., c. 12.

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than mine. On the contrary, in parts of Europe where earthquakes are rare compared to America, scientific observers are inclined to admit an intimate connection between the undulations of the ground, and certain meteors, which appear simultaneously with them. In Italy for instance, the sirocco and earthquakes are suspected to have some connection; and in London, the frequency of falling-stars, and those southern lights which have since been often observed by Mr. Dalton, were considered as the forerunners of those shocks which were felt from 1748 to 1756.

On days when the earth is shaken by violent shocks, the regularity of the horary variations of the barometer is not disturbed within the tropics. I had opportunities of verifying this observation at Cumana, at Lima, and at Riobamba; and it is the more worthy of attention, as at St. Domingo, (in the town of Cape François,) it is asserted, that a water-barometer sank two inches and a half immediately before the earthquake of 1770. It is also related, that, at the time of the destruction of Oran, a druggist fled with his family, because, observing accidentally, a few minutes before the earthquake, the height of the mercury in his barometer, he perceived that the column sank in an extraordinary manner. I know not whether we can give credit to this story; but as it is nearly impossible to examine the variations of the weight of the atmosphere during the shocks, we must be satisfied with observing the barometer before or after these phenomena have taken place.

We can scarcely doubt, that the earth, when opened and agitated by shocks, spreads occasionally gaseous emanations through the atmosphere, in places remote from the mouths of volcanoes not extinct. At Cumana, it has already been observed that flames and vapours mixed with sulphurous acid spring up from the most arid soil. In other parts of the same province, the earth ejects water and petroleum. At Riobamba, a muddy and inflammable mass, called *moya*, issues from crevices that close again, and accumulates into elevated hills. At about seven leagues from Lisbon, near Colares, during the terrible earthquake of the 1st of November, 1755, flames and a column of thick smoke were seen to issue from the flanks of the rocks of Alvidras, and, according to some witnesses, from the bosom of the sea.

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Elastic fluids thrown into the atmosphere may act locally on the barometer, not by their mass, which is very small, compared to the mass of the atmosphere, but because, at the moment of great explosions, an ascending current is probably formed, which diminishes the pressure of the air. I am inclined to think that in the majority of earthquakes nothing escapes from the agitated earth; and that, when gaseous emanations and vapours are observed, they oftener accompany or follow, than precede the shocks. This circumstance would seem to explain the mysterious influence of earthquakes in equinoctial America, on the climate, and on the order of the dry and rainy seasons. If the earth generally act on the air only at the moment of the shocks, we can conceive why a sensible meteorological change so rarely precedes those great revolutions of nature.

The hypothesis according to which, in the earthquakes of Cumana, elastic fluids tend to escape from the surface of the soil, seems confirmed by the great noise which is heard during the shocks at the borders of the wells in the plain of Charas. Water and sand are sometimes thrown out twenty feet high. Similar phenomena were observed in ancient times by the inhabitants of those parts of Greece and Asia Minor abounding with caverns, crevices, and subterraneous rivers. Nature, in her uniform progress, everywhere suggests the same ideas of the causes of earthquakes, and the means by which man, forgetting the measure of his strength, pretends to diminish the effect of the subterraneous explosions. What a great Roman naturalist has said of the utility of wells and caverns* is repeated in the New World by the most ignorant Indians of Quito, when they show travellers the guaicos, or crevices of Pichincha.

The subterranean noise, so frequent during earthquakes,

* "In puteis est remedium, quale et crebri specus præbent: conceptum enim spiritum exhalant: quod in certis notatur oppidis, quæ minus quatiuntur, crebris ad eluviem cuniculis cavata."—Pliny, lib. ii, c. 82 (ed. Par. 1723, t. i., p. 112.) Even at present, in the capital of St. Domingo, wells are considered as diminishing the violence of the shocks. I may observe on this occasion, that the theory of earthquakes, given by Seneca, (Nat. Quæst., lib. vi., c. 4—31), contains the germ of everything that has been said in our times on the action of the elastic vapours confined in the interior of the globe.

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is generally not in the ratio of the force of the shocks. At Cumana it constantly precedes them, while at Quito, and recently at Caracas, and in the West India Islands, a noise like the discharge of a battery was heard a long time after the shocks had ceased. A third kind of phenomenon, the most remarkable of the whole, is the rolling of those subterranean thunders, which last several months, without being accompanied by the least oscillatory motion of the ground.*

In every country subject to earthquakes, the point at which, probably owing to a particular disposition of the stony strata, the effects are most sensibly felt, is considered as the cause and the focus of the shocks. Thus, at Cumana, the hill of the castle of San Antonio, and particularly the eminence on which stands the convent of St. Francis, are believed to contain an enormous quantity of sulphur and other inflammable matter. We forget that the rapidity with which the undulations are propagated to great distances, even across the basin of the ocean, proves that the centre of action is very remote from the surface of the globe. From this same cause no doubt earthquakes are not confined to certain species of rocks, as some naturalists suppose, but all are fitted to propagate the movement. Keeping within the limits of my own experience I may here cite the granites of Lima and Acapulco; the gneiss of Caracas; the mica-slate of the peninsula of Araya; the primitive thonschiefer of Tepecuacuilco, in Mexico; the secondary limestones of the Apennines, Spain, and New Andalusia; and finally, the trappean porphyries of the provinces of Quito and Popayan.† In these different places the ground is frequently agitated by the most violent shocks; but sometimes, in the same rock, the superior strata form invincible obstacles to the

* The subterranean thunders (bramidos y truenos subterraneos) of Guanaxuato. The phenomenon of a noise without shocks was observed by the ancients.—Aristot. Meteor., lib. ii., (ed. Duval, p. 802). Pliny, lib. ii., c. 80.

† I might add to the list of secondary rocks, the gypsum of the newest formation, for instance, that of Montmartre, situated on a marine calcareous rock, which is posterior to the chalk.—See the Mémoires de l'Académie, tom. i., p. 341, on the earthquake felt at Paris and its environs in 1681.

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propagation of the motion. Thus, in the mines of Saxony, we have seen workmen hasten up alarmed by oscillations which were not felt at the surface of the ground.

If, in regions the most remote from each other, primitive, secondary, and volcanic rocks, share equally in the convulsive movements of the globe; we cannot but admit also that within a space of little extent, certain classes of rocks oppose themselves to the propagation of the shocks. At Cumana, for instance, before the great catastrophe of 1797, the earthquakes were felt only along the southern and calcareous coast of the gulf of Cariaco, as far as the town of that name; while in the peninsula of Araya, and at the village of Maniquarez, the ground did not share the same agitation. But since December 1797, new communications appear to have been opened in the interior of the globe. The peninsula of Araya is now not merely subject to the same agitations as the soil of Cumana, but the promontory of mica-slate, previously free from earthquakes, has become in its turn a central point of commotion. The earth is sometimes strongly shaken at the village of Maniquarez, when on the coast of Cumana the inhabitants enjoy the most perfect tranquillity. The gulf of Cariaco, nevertheless, is only sixty or eighty fathoms deep.

It has been thought from observations made both on the continent and in the islands, that the western and southern coasts are most exposed to shocks. This observation is connected with opinions which geologists have long formed respecting the position of the high chains of mountains, and the direction of their steepest declivities; but the existence of the Cordillera of Caracas, and the frequency of the oscillations on the eastern and northern coast of Terra Firma, in the gulf of Paria, at Carupano, at Cariaco, and at Cumana, render the accuracy of that opinion doubtful.

In New Andalusia, as well as in Chile and Peru, the shocks follow the course of the shore, and extend but little inland. This circumstance, as we shall soon find, indicates an intimate connection between the causes which produce earthquakes and volcanic eruptions. If the earth was most agitated on the coasts, because they are the lowest part of the land, why should not the oscillations be equally strong

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and frequent on those vast savannahs or prairies,* which are scarcely eight or ten toises above the level of the ocean?

The earthquakes of Cumana are connected with those of the West India Islands; and it has even been suspected that they have some connection with the volcanic phenomena of the Cordilleras of the Andes. On the 4th of February, 1797, the soil of the province of Quito suffered such a destructive commotion, that near 40,000 natives perished. At the same period the inhabitants of the eastern Antilles were alarmed by shocks, which continued during eight months, when the volcano of Guadaloupe threw out pumice-stones, ashes, and gusts of sulphureous vapours. The eruption of the 27th of September, during which very long-continued subterranean noises were heard, was followed on the 14th of December by the great earthquake of Cumana. Another volcano of the West India Islands, that of St. Vincent, affords an example of these extraordinary connections. This volcano had not emitted flames since 1718, when they burst forth anew in 1812. The total ruin of the city of Caracas preceded this explosion thirty-five days, and violent oscillations of the ground were felt both in the islands and on the coasts of Terra Firma.

It has long been remarked that the effects of great earthquakes extend much farther than the phenomena arising from burning volcanoes. In studying the physical revolutions of Italy, in carefully examining the series of the eruptions of Vesuvius and Etna, we can scarcely recognise, notwithstanding the proximity of these mountains, any traces of a simultaneous action. It is on the contrary beyond a doubt, that at the period of the last and preceding destruction of Lisbon,† the sea was violently agitated even as far as the

* The Llanos of Cumana, of New Barcelona, of Calabozo, of Apure, and of Meta.

† The 1st of November, 1755, and 31st of March, 1761. During the first of these earthquakes, the sea inundated, in Europe, the coasts of Sweden, England, and Spain; in America, the islands of Antigua, Barbadoes, and Martinique. At Barbadoes, where the ordinary tides rise only from twenty-four to twenty-eight inches, the water rose twenty feet in Carlisle Bay. It became at the same time as black as ink; being, without doubt, mixed with the petroleum, or asphaltum, which abounds at the bottom of the sea, as well on the coasts of the gulf of Cariaco, as

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New World, for instance, at the island of Barbadoes, more than twelve hundred leagues distant from the coasts of Portugal.

Several facts tend to prove that the causes which produce earthquakes have a near connection with those which act in volcanic eruptions. The connection of these causes was known to the ancients, and it excited fresh attention at the period of the discovery of America. The discovery of the New World not only offered new productions to the curiosity of man, it also extended the then existing stock of knowledge respecting physical geography, the varieties of the human species, and the migrations of nations. It is impossible to read the narratives of early Spanish travellers, especially that of the Jesuit Acosta, without perceiving the influence which the aspect of a great continent, the study of extraordinary appearances of nature, and intercourse with men of different races, must have exercised

near the island of Trinidad. In the West Indies, and in several lakes of Switzerland, this extraordinary motion of the waters was observed six hours after the first shock that was felt at Lisbon.—Phil. Trans., vol. xlix, pp. 403, 410, 544, 668; ibid. vol. liii, p. 424. At Cadiz a mountain of water sixty feet high was seen eight miles distant at sea. This mass threw itself impetuously on the coasts, and beat down a great number of houses; like the wave eighty-four feet high, which on the 9th of June, 1586, at the time of the great earthquake of Lima, covered the port of Callao.—Acosta, Hist. Natural de las Indias, ed. de 1591, p. 123. In North America, on Lake Ontario, violent agitations of the water were observed from the month of October 1755. These phenomena are proofs of subterraneous communications at enormous distances. On comparing the periods of the great catastrophes of Lima and Guatimala, which generally succeed each other at long intervals, it has sometimes been thought, that the effect of an action slowly propagating along the Cordilleras, sometimes from north to south, at other times from south to north, may be perceived.—Cosmo Bueno, Descripcion del Peru, ed. de Lima, p. 67. Four of these remarkable catastrophes, with their dates, may be here enumerated.

Mexico. (Lat. 13° 32′ north.)	Peru. (Lat. 12° 2′ south.)
30th of November, 1577.	17th of June, 1578.
4th of March, 1679.	17th of June, 1678.
12th of February, 1689.	10th of October, 1688.
27th of September, 1717.	8th of February, 1716.

When the shocks are not simultaneous, or do not follow each other at short intervals, great doubts may be entertained with respect to the supposed communication of the movement.

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on the progress of knowledge in Europe. The germ of a great number of physical truths is found in the works of the sixteenth century; and that germ would have fructified, had it not been crushed by fanaticism and superstition. We learned, at Pasto, that the column of black and thick smoke, which, in 1797, issued for several months from the volcano near that shore, disappeared at the very hour, when, sixty leagues to the south, the towns of Riobamba, Hambato, and Tacunga were destroyod by an enormous shock. In the interior of a burning crater, near those hillocks formed by ejections of scoriæ and ashes, the motion of the ground is felt several seconds before each partial eruption takes place. We observed this phenomenon at Vesuvius in 1805, while the mountain threw out incandescent scoriæ; we were witnesses of it in 1802, on the brink of the immense crater of Pichincha, from which, nevertheless, at that time, clouds of sulphureous acid vapours only issued.

Everything in earthquakes seems to indicate the action of elastic fluids seeking an outlet to diffuse themselves in the atmosphere. Often, on the coasts of the Pacific, the action is almost instantaneously communicated from Chile to the gulf of Guayaquil, a distance of six hundred leagues; and, what is very remarkable, the shocks appear to be the stronger in proportion as the country is distant from burning volcanoes. The granitic mountains of Calabria, covered with very recent breccias, the calcareous chain of the Apennines, the country of Pignerol, the coasts of Portugal and Greece, those of Peru and Terra Firma, afford striking proofs of this fact. The globe, it may be said, is agitated with the greater force, in proportion as the surface has a smaller number of funnels communicating with the caverns of the interior. At Naples and at Messina, at the foot of Cotopaxi and of Tunguragua, earthquakes are dreaded only when vapours and flames do not issue from the craters. In the kingdom of Quito, the great catastrophe of Riobamba led several well-informed persons to think that that country would be less frequently disturbed, if the subterranean fire should break the porphyritic dome of Chimborazo; and if that colossal mountain should become a burning volcano. At all times analogous facts have led to the same hypotheses. The Greeks, who, like ourselves, attributed the oscillations

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of the ground to the tension of elastic fluids, cited in favour of their opinion, the total cessation of the shocks at the island of Eubœa, by the opening of a crevice in the Lelantine plain.*

The phenomena of volcanoes, and those of earthquakes, have been considered of late as the effects of voltaic electricity, developed by a particular disposition of heterogeneous strata. It cannot be denied, that often, when violent shocks succeed each other within the space of a few hours, the electricity of the air sensibly increases at the instant the ground is most agitated; but to explain this phenomenon, it is unnecessary to recur to an hypothesis, which is in direct contradiction to everything hitherto observed respecting the structure of our planet, and the disposition of its strata.

Chapter V.

Peninsula of Araya.—Salt-marshes.—Ruins of the Castle of Santiago.

The first weeks of our abode at Cumana were employed in testing our instruments, in herborizing in the neighbouring plains, and in examining the traces of the earthquake of the 14th of December, 1797. Overpowered at once by a great number of objects, we were somewhat embarrassed how to lay down a regular plan of study and observation. Whilst every surrounding object was fitted to inspire in us the most lively interest, our physical and astronomical instruments in their turns excited strongly the curiosity of the inhabitants. We had numerous visitors; and in our desire to satisfy persons who appeared so happy to see the spots of the moon through Dollond's telescope, the absorption of two gases in a eudiometrical tube, or the effects of galvanism on the motions of a frog, we were obliged to answer questions often obscure, and to repeat for whole hours the same experiments. These scenes were renewed for the space of five years, whenever we took up our abode in a place where it was understood

* "The shocks ceased only when a crevice, which ejected a river of fiery mud, opened in the plain of Lelantum, near Chalcis."—Strabo.

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that we were in possession of microscopes, telescopes, and electrical apparatus.

I could not begin a regular course of astronomical observations before the 28th of July, though it was highly important for me to know the longitude given by Berthoud's time-keeper; but it happened, that in a country where the sky is constantly clear and serene, no stars appeared for several nights. The whole series of the observations I made in 1799 and 1800 give for their results, that the latitude of the great square at Cumana is 10° 27′ 52″, and its longitude 66° 30′ 2″. This longitude is founded on the difference of time, on lunar distances, on the eclipse of the sun (on the 28th of October, 1799), and on ten immersions of Jupiter's satellites, compared with observations made in Europe. The oldest chart we have of the continent, that of Don Diego Ribeiro, geographer to the emperor Charles the Fifth, places Cumana in latitude 9° 30′; which differs fifty-eight minutes from the real latitude, and half a degree from that marked by Jefferies in his American Pilot, published in 1794. During three centuries the whole of the coast of Terra Firma has been laid down too far to the south: this has been owing to the current near the island of Trinidad, which sets toward the north, and mariners are led by their dead-reckoning to think themselves farther south than they really are.

On the 17th of August a halo round the moon fixed the attention of the inhabitants of Cumana, who considered it as the presage of some violent earthquake; for, according to popular notions, all extraordinary phenomena are immediately connected with each other. Coloured circles around the moon are much more rare in northern countries, than in Provence, Italy, and Spain. They are seen particularly (and this fact is singular enough) when the sky is clear, and the weather seems to be most fair and settled. Under the torrid zone beautiful prismatic colours appear almost every night, and even at the time of the greatest droughts; often in the space of a few minutes they disappear several times, because, doubtless, the superior currents change the state of the floating vapours, by which the light is refracted. I sometimes even observed, between the fifteenth degree of latitude and the equator, small halos

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around the planet Venus; the purple, orange, and violet, were distinctly perceived: but I never saw any colours around Sirius, Canopus, or Acherner.

While the halo was visible at Cumana, the hygrometer denoted great humidity; nevertheless the vapours appeared so perfectly in solution, or rather so elastic and uniformly disseminated, that they did not alter the transparency of the atmosphere. The moon arose after a storm of rain, behind the castle of San Antonio. As soon as she appeared on the horizon, we distinguished two circles: one large and whitish, forty-four degrees in diameter; the other a small circle of 1° 43′, displaying all the colours of the rainbow. The space between the two circles was of the deepest azure. At four degrees height, they disappeared, while the meteorological instruments indicated not the slightest change in the lower regions of the air. This phenomenon had nothing extraordinary, except the great brilliancy of the colours, added to the circumstance, that, according to the measures taken with Ramsden's sextant, the lunar disk was not exactly in the centre of the haloes. Without this actual measurement we might have thought that the excentricity was the effect of the projection of the circles on the apparent concavity of the sky.

If the situation of our house at Cumana was highly favourable for the observation of the stars and meteorological phenomena, it obliged us to be sometimes the witnesses of painful scenes during the day. A part of the great square is surrounded with arcades, above which is one of those long wooden galleries, common in warm countries. This was the the place where slaves, brought from the coast of Africa, were sold. Of all the European governments Denmark was the first, and for a long time the only power, which abolished the traffic; yet notwithstanding that fact, the first negroes we saw exposed for sale had been landed from a Danish slave-ship. What are the duties of humanity, national honour, or the laws of their country, to men stimulated by the speculations of sordid interest?

The slaves exposed to sale were young men from fifteen to twenty years of age. Every morning cocoa-nut oil was distributed among them, with which they rubbed their

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bodies, to give their skin a black polish. The persons who came to purchase examined the teeth of these slaves, to judge of their age and health; forcing open their mouths as we do those of horses in a market. This odious custom dates from Africa, as is proved by the faithful pictures drawn by the inimitable Cervantes,* who after his long captivity among the Moors, described the sale of Christian slaves at Algiers. It is distressing to think that even at this day there exist European colonists in the West Indies who mark their slaves with a hot iron, to know them again if they escape. This is the treatment bestowed on those "who save other men the labour of sowing, tilling, and reaping."†

In 1800 the number of slaves did not exceed six thousand in the two provinces of Cumana and Barcelona, when at the same period the whole population was estimated at one hundred and ten thousand inhabitants. The trade in African slaves, which the laws of the Spaniards have never favoured, is almost as nothing on these coasts where the trade in American slaves was carried on in the sixteenth century with desolating activity. Macarapan, anciently called Amaracapana, Cumana, Araya, and particularly New Cadiz, built on the islet of Cubagua, might then be considered as commercial establishments for facilitating the slave trade. Girolamo Benzoni of Milan, who at the age of twenty-two visited Terra Firma, took part in some expeditions in 1542 to the coasts of Bordones, Cariaco, and Paria, to carry off the unfortunate natives. He relates with simplicity, and often with a sensibility not common in the historians of that time, the examples of cruelty of which he was a witness. He saw the slaves dragged to New Cadiz, to be marked on the forehead and on the arms, and for the payment of the *quint* to the officers of the crown. From this port the Indians were sent to the island of Hayti or St. Domingo, after having often changed masters, not by

* El Trato de Argel. Jorn. II. Viage al Parnasso (1784), p. 316.

† La Bruyère, Caractères, chap. xi. (ed. 1765), p. 300. I will here cite a passage strongly characteristic of La Bruyère's benevolent feeling for his fellow-creatures. "We find (under the torrid zone) certain wild animals, male and female, scattered through the country, black, livid, and all over scorched by the sun, bent to the earth which they dig and turn up with invincible perseverance. They have something like articulate utterance; and when they stand up on their feet, they exhibit a human face, and in fact these creatures are men."

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way of sale, but because the soldiers played for them at dice.

The first excursion we made was to the peninsula of Araya, and those countries formerly celebrated for the slave-trade and the pearl-fishery. We embarked on the Rio Manzanares, near the Indian suburb, on the 19th of August, about two in the morning. The principal objects of this excursion were, to see the ruins of the castle of Araya, to examine the salt-works, and to make a few geological observations on the mountains forming the narrow peninsula of Maniquarez. The night was delightfully cool; swarms of phosphorescent insects * glistened in the air, and over a soil covered with sesuvium, and groves of mimosa which bordered the river. We know how common the glow-worm † is in Italy and in all the south of Europe, but the picturesque effect it produces cannot be compared to those innumerable, scattered, and moving lights, which embellish the nights of the torrid zone, and seem to repeat on the earth, along the vast extent of the savannahs, the brilliancy of the starry vault of heaven.

When, on descending the river, we drew near plantations, or *charas*, we saw bonfires kindled by the negroes. A light and undulating smoke rose to the tops of the palm-trees, and imparted a reddish hue to the disk of the moon. It was on a Sunday night, and the slaves were dancing to the music of the guitar. The people of Africa, of negro race, are endowed with an inexhaustible store of activity and gaiety. After having ended the labours of the week, the slaves, on festival days, prefer to listless sleep the recreations of music and dancing.

The bark in which we passed the gulf of Cariaco was very spacious. Large skins of the jaguar, or American tiger, were spread for our repose during the night. Though we had yet scarcely been two months in the torrid zone, we had already become so sensible to the smallest variation of temperature that the cold prevented us from sleeping; while, to our surprise, we saw that the centigrade thermometer was as high as 21·8°. This fact is familiar to those who have lived long in the Indies, and is worthy the

* Elater noctilucus. † Lampyris italica, L. noctiluca.

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attention of physiologists. Bouguer relates, that when he reached the summit of Montagne Pelée, in the island of Martinique, he and his companions shivered with cold, though the heat was above 21·5°. In reading the interesting narrative of captain Bligh, who, in consequence of a mutiny on board the Bounty, was forced to make a voyage of twelve hundred leagues in an open boat, we find that that navigator, in the tenth and twelfth degrees of south latitude, suffered much more from cold than from hunger. During our abode at Guayaquil, in the month of January 1803, we observed that the natives covered themselves, and complained of the cold, when the thermometer sunk to 23·8°, whilst they felt the heat suffocating at 30·5°. Six or seven degrees were sufficient to cause the opposite sensations of cold and heat; because, on these coasts of South America, the ordinary temperature of the atmosphere is twenty-eight degrees. The humidity, which modifies the conducting power of the air for heat, contributes greatly to these impressions. In the port of Guayaquil, as everywhere else in the low regions of the torrid zone, the weather grows cool only after storms of rain: and I have observed that when the thermometer sinks to 23·8°, De Luc's hygrometer keeps up to fifty and fifty-two degrees; it is, on the contrary, at thirty-seven degrees in a temperature of 30·5°. At Cumana, during very heavy showers, people in the streets are heard exclaiming, *que hielo! estoy emparamado;** though the thermometer

* "What an icy cold! I shiver as if I was on the top of the mountains." The provincial word *emparamarse* can be translated only by a very long periphrasis. *Paramo*, in Peruvian *puna*, is a denomination found on all the maps of Spanish America. In the colonies it signifies neither a desert nor a heath, but a mountainous place covered with stunted trees, exposed to the winds, and in which a damp cold perpetually reigns. In the torrid zone, the paramos are generally from one thousand six hundred to two thousand toises high. Snow often falls on them, but it remains only a few hours; for we must not confound, as geographers often do, the words *paramo* and *puna* with that of *nevado*, in Peruvian *ritticapa*, a mountain which enters into the limits of perpetual snow. These notions are highly interesting to geology and the geography of plants; because, in countries where no height has been measured, we may form an exact idea of the lowest height to which the Cordilleras rise, on looking into the map for the words *paramo* and *nevado*. As the *paramos* are almost continually enveloped in a cold and thick fog, the people say at Santa Fé and at Mexico, *cae un paramito*,

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exposed to the rain sinks only to 21·5°. From these observations it follows, that between the tropics, in plains where the temperature of the air is in the day-time almost invariably above twenty-seven degrees, warmer clothing during the night is requisite, whenever in a damp air the thermometer sinks four or five degrees.

We landed about eight in the morning at the point of Araya, near the new salt-works. A solitary house, near a battery of three guns, the only defence of this coast, since the destruction of the fort of Santiago, is the abode of the inspector. It is surprising that these salt-works, which formerly excited the jealousy of the English, Dutch, and other maritime powers, have not created a village, or even a farm; a few huts only of poor Indian fishermen are found at the extremity of the point of Araya.

This spot commands a view of the islet of Cubagua, the lofty hills of Margareta, the ruins of the castle of Santiago, the Cerro de la Vela, and the calcareous chain of the Brigantine, which bounds the horizon towards the south. I availed myself of this view to take the angles between these different points, from a basis of four hundred toises, which I measured between the battery and the hill called the *Peña*. As the Cerro de la Vela, the Brigantine, and the castle of San Antonio at Cumana, are equally visible from the Punta Arenas, situated to the west of the village of Maniquarez, the same objects were available for an approximate determination of the respective positions of several points, which are laid down in the mineralogical chart of the peninsula of Araya.

The abundance of salt contained in the peninsula of Araya was known to Alonzo Niño, when, following the tracks of Columbus, Ojeda, and Amerigo Vespucci, he visited these countries in 1499. Though of all the people on the globe the natives of South America consume the least salt, because they scarcely eat anything but vegetables, it nevertheless appears, that at an early period the Guayquerias dug into the clayey and muriatiferous soil of Punta Arenas Even the brine-pits, now called new, (*la salina nueva,*)

when a thick small rain falls, and the temperature of the air sinks considerably. From *paramo* has been made *emparamarse*, which signifies to be as cold as if we were on the ridge of the Andes.

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situated at the extremity of Cape Araya, were worked in very remote times. The Spaniards, who settled at first at Cubagua, and soon after on the coasts of Cumana, worked, from the beginning of the sixteenth century, the salt marshes which stretch away like a lagoon to the north of Cerro de la Vela. As at that period the peninsula of Araya had no settled population, the Dutch availed themselves of the natural riches of a soil which appeared to be property common to all nations. In our days, each colony has its own salt-works, and navigation is so much improved, that the merchants of Cadiz can send, at a small expense, salt from Spain and Portugal to the southern hemisphere, a distance of 1900 leagues, to cure meat at Monte Video and Buenos Ayres. These advantages were unknown at the time of the conquest; colonial industry had then made so little progress, that the salt of Araya was carried, at great expense, to the West India Islands, Carthagena, and Portobello. In 1605, the court of Madrid sent armed ships to Punta Araya, with orders to expel the Dutch by force of arms. The Dutch, however, continued to carry on a contraband trade in salt till, in 1622, there was built near the salt-works a fort, which afterwards became celebrated under the name of the Castillo de Santiago, or the Real Fuerza de Araya. The great salt-marshes are laid down on the oldest Spanish maps, sometimes as a bay, and at other times as a lagoon. Laet, who wrote his *Orbis Novus* in 1633, and who had some excellent notions respecting these coasts, expressly states, that the lagoon was separated from the sea by an isthmus above the level of high water. In 1726, an impetuous hurricane destroyed the salt-works of Araya, and rendered the fort, the construction of which had cost more than a million of piastres, useless. This hurricane was a very rare phenomenon in these regions, where the sea is in general as calm as the water in our large rivers. The waves overflowed the land to a great extent; and by the effect of this eruption of the ocean the salt lake was converted into a gulf several miles in length. Since that period, artificial reservoirs, or pits, (*vasets*,) have been formed, to the north of the range of hills which separates the castle from the north coast of the peninsula.

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The consumption of salt amounted, in 1799 and 1800, in the two provinces of Cumana* and Barcelona, to nine or ten thousand *fanegas*, each sixteen *arrobas*, or four hundredweight. This consumption is very considerable, and gives, if we deduct from the total population fifty thousand Indians, who eat very little salt, sixty pounds for each person. Salt beef, called *tasajo*, is the most important article of export from Barcelona. Of nine or ten thousand *fanegas* furnished by the two provinces conjointly, three thousand only are produced by the salt-works of Araya; the rest is extracted from the sea-water at the Morro of Barcelona, at Pozuelos, at Piritu, and in the Golfo Triste. In Mexico, the salt lake of Peñon Blanco alone furnishes yearly more than two hundred and fifty thousand *fanegas* of unpurified salt.

The province of Caracas possesses fine salt-works at Los Roques; those which formerly existed at the small island of Tortuga, where the soil is strongly impregnated with muriate of soda, were destroyed by order of the Spanish government. A canal was made by which the sea has free access to the salt-marshes. Foreign nations who have colonies in the West Indies frequented this uninhabited island; and the court of Madrid, from views of suspicious policy, was apprehensive that the salt-works of Tortuga would give rise to settlements, by means of which an illicit trade would be carried on with Terra-Firma.

The royal administration of the salt-works of Araya dates only from the year 1792. Before that period they were in the hands of Indian fishermen, who manufactured salt at

* At the period of my visit to that country the government of Cumana comprehended the two provinces of New Andalusia and New Barcelona. The words province and govierno, or government of Cumana, are consequently not synonymous. A Catalonian, Juan de Urpin, who had been by turns a canon, a doctor of laws, a counsellor in St. Domingo, and a private soldier in the castle of Araya, founded in 1636, the city of New Barcelona, and attempted to give the name of New Catalonia (Nueva Cathaluña) to the province of which this newly constructed city became the capital. This attempt was fruitless; and it is from the capital that the whole province took its name. Since my departure from America, it has been raised to the rank of a Govierno. In New Andalusia, the Indian name of Cumana has superseded the names Nueva Toledo and Nueva Cordoba, which we find on the maps of the seventeenth century.

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their pleasure, and sold it, paying the government the moderate sum of three hundred piastres. The price of the fanega was then four reals;* but the salt was extremely impure, grey, mixed with earthy particles, and surcharged with muriate and sulphate of magnesia. Since the province of Cumana has become dependent on the intendancia of Caracas, the sale of salt is under the control of the excise; and the fanega, which the Guayquerias sold at half a piastre, costs a piastre and a half.† This augmentation of price is slightly compensated by greater purity of the salt, and by the facility with which the fishermen and farmers can procure it in abundance during the whole year. The salt-works of Araya yielded to the treasury, in 1799, a clear income of eight thousand piastres.

Considered as a branch of industry the salt produced here is not of any great importance, but the nature of the soil which contains the salt-marshes is well worthy of attention. In order to obtain a clear idea of the geological connection existing between this muriatiferous soil and the rocks of more ancient formation, we shall take a general view of the neighbouring mountains of Cumana, and those of the peninsula of Araya, and the island of Margaretta.

Three great parallel chains extend from east to west. The two most northerly chains are primitive, and contain the mica-slates of Macanao, and the San Juan Valley, of Maniquarez, and of Chuparipari. These we shall distinguish by the names of Cordillera of the island of Margareta, and Cordillera of Araya. The third chain, the most southerly of the whole, the Cordillera of the Brigantine and of the Cocollar, contains rocks only of secondary formation; and, what is remarkable enough, though analogous to the geological constitution of the Alps westward of St. Gothard, the primitive chain is much less elevated than that which was composed of

* In this narrative, as well as in the Political Essay on New Spain, all the prices are reckoned in piastres, and silver reals (reales de plata). Eight of these reals are equivalent to a piastre, or one hundred and five sous, French money (4*s.* 4½*d.* English). Nouv. Esp., vol. ii., p. 519, 616, and 866.

† The fanega of salt is sold to those Indians and fishermen who do not pay the duties (derechos reales), at Punta Araya for six, at Cumana for eight reals. The prices to the other tribes are, at Araya ten, at Cumana twelve reals.

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secondary rocks.* The sea has separated the two northern Cordilleras, those of the island of Margareta and the peninsula of Araya; and the small islands of Coche and of Cubagua are remnants of the land that was submerged. Farther to the south, the vast gulf Cariaco stretches away, like a longitudinal valley formed by the irruption of the sea, between the two small chains of Araya and the Cocollar, between the mica-slate and the Alpine limestone. We shall soon see that the direction of the strata, very regular in the first of these rocks, is not quite parallel with the general direction of the gulf. In the high Alps of Europe, the great longitudinal valley of the Rhone also sometimes cuts at an oblique angle the calcareous banks in which it has been excavated.

The two parallel chains of Araya and the Cocollar were connected, to the east of the town of Cariaco, between the lakes of Campoma and Putaquao, by a kind of transverse dyke, which bears the name of Cerro de Meapire, and which in distant times, by resisting the impulse of the waves, has hindered the waters of the gulf of Cariaco from uniting with those of the gulf of Paria. Thus, in Switzerland, the central chain, that which passes by the Col de Ferrex, the Simplon, St. Gothard, and the Splügen, is connected on the north and the south with two lateral chains, by the mountains of Furca and Maloya. It is interesting to recall to mind those striking analogies exhibited in both continents by the external structure of the globe.

The primitive chain of Araya ends abruptly in the meridian of the village of Maniquarez; and the western slope of the peninsula, as well as the plains in the midst of which stands the castle of San Antonio, is covered with very recent formations of sandstone and clay mixed with gypsum. Near Maniquarez, breccia or sandstone with calcareous cement,

* In New Andalusia, the Cordillera of the Cocollar nowhere contains primitive rocks. If these rocks form the nucleus of this chain, and rise above the level of the neighbouring plains, which is scarcely probable, we must suppose that they are all covered with limestone and sandstone. In the Swiss Alps, on the contrary, the chain which is designated under the too vague denomination of lateral and calcareous, contains primitive rocks, which, according to the observations of Escher and Leopold von Buch, are often visible to the height of eight hundred or a thousand toises.

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which might easily be confounded with real limestone, lies immediately over the mica-slate; while on the opposite side, near Punta Delgada, this sandstone covers a compact bluish gray limestone, almost destitute of petrifactions, and traversed by small veins of calcareous spar. This last rock is analogous to the limestone of the high Alps.*

The very recent sandstone formation of the peninsula of Araya contains:—first, near Punta Arenas, a stratified sandstone, composed of very fine grains, united by a calcareous cement in small quantity;—secondly, at the Cerro de la Vela, a schistose sandstone,† without mica, and passing into slate-clay,‡ which accompanies coal;—thirdly, on the western side, between Punta Gorda and the ruins of the castle of Santiago, breccia composed of petrified sea-shells united by a calcareous cement, in which are mingled grains of quartz;—fourthly, near the point of Barigon, whence the stone employed for building at Cumana is obtained, banks of yellowish white shelly limestone, in which are found some scattered grains of quartz;—fifthly, at Peñas Negras, at the top of the Cerro de la Vela, a bluish gray compact limestone, very tender, almost without petrifactions, and covering the schistose sandstone. However extraordinary this mixture of sandstone and compact limestone§ may appear, we cannot doubt that these strata belong to one and the same formation. The very recent secondary rocks everywhere present analogous phenomena; the molasse of the Pays de Vaud contains a fetid shelly limestone, and the cerite limestone of the banks of the Seine is sometimes mixed with sandstone.

The strata of calcareous breccia are composed of an infinite number of sea-shells, from four to six inches in diameter, and in part well preserved. We find they contain not ammonites, but ampullaires, solens, and terebratulæ. The greater part of these shells are mixed: the oysters and pectinites being sometimes arranged in families. The whole are easily detached, and their interior is filled with fossil madrepores and cellepores. We have now to speak of a fourth formation, which probably rests‖ on the calcareous

* Alpenkalkstein.

† Sandsteinschiefer. ‡ Thonschiefer. § Dichter kalkstein.

‖ It were to be wished that mineralogical travellers would examine more particularly the Cerro de la Vela. The limestone of the Peñas Negras

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sandstone of Araya, I mean the muriatiferous clay. This clay, hardened, impregnated with petroleum, and mixed with lamellar and lenticular gypsum, is analogous to the salzthon, which in Europe accompanies the sal-gem of Berchtesgaden, and in South America that of Zipaquira. It is generally of a smoke-grey colour, earthy, and friable; but it encloses more solid masses of a blackish brown, of a schistose, and sometimes conchoidal fracture. These fragments, from six to eight inches long, have an angular form. When they are very small, they give the clay a porphyroidal appearance. We find disseminated in it, as we have already observed, either in nests or in small veins, selenite, and sometimes, though seldom, fibrous gypsum. It is remarkable enough, that this stratum of clay, as well as the banks of pure salgem and the salzthon in Europe, scarcely ever contains shells, while the rocks adjacent exhibit them in great abundance.

Although the muriate of soda is not found visible to the eye in the clay of Araya, we cannot doubt of its existence. It shows itself in large crystals, if we sprinkle the mass with rain-water and expose it to the sun. The lagoon to the east of the castle of Santiago exhibits all the phenomena which have been observed in the salt lakes of Siberia, described by Lepechin, Gmelin, and Pallas. This lagoon receives, however, only the rain-waters, which filter through the banks of clay, and unite at the lowest point of the peninsula. While the lagoon served as a salt-work to the Spaniards and the Dutch, it did not communicate with the sea; at present this communication has been interrupted anew, by faggots placed at the place where the waters of the ocean made an irruption in 1726. After great droughts, crystallized and very pure muriate of soda, in masses of three or four cubic feet, is still drawn from time to time from the bottom of the lagoon. The salt waters of the lake, exposed

rests on a slate-clay, mixed with quartzose sand; but there is no proof of the muriatiferous clay of the salt-works being of more ancient formation than this slate-clay, or of its alternating with banks of sandstone. No well having been dug in these countries, we can have no information respecting the superposition of the strata. The banks of calcareous sandstone, which are found at the mouth of the salt lake, and near the fishermen's huts on the coast opposite Cape Macano, appeared to me to lie beneath the muriatiferous clay.

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to the heat of the sun, evaporate at their surface; crusts of salt, formed in a saturated solution, fall to the bottom; and by the attraction between chrystals of a similar nature and form, the crystallized masses daily augment. It is generally observed that the water is brackish wherever lagoons are formed in clayey ground. It is true, that for the new salt-work near the battery of Araya, the sea-water is received into pits, as in the salt marshes of the south of France; but in the island of Margareta, near Pampatar, salt is manufactured by employing only fresh water, with which the muriatiferous clay has first been lixivated.

We must not confound the salt disseminated in these clayey soils with that contained in the sands of the sea-shore, on the coasts of Normandy. These phenomena, considered in a geognostical point of view, have scarcely any properties in common. I have seen muriatiferous clay at the level of the ocean at Punta Araya, and at two thousand toises' height in the Cordilleras of New Grenada. If in the former of these places it lies on very recent shelly breccia, it forms, on the contrary, in Austria near Ischel, a considerable stratum in the Alpine lime-stone, which, though equally posterior to the existence of organic life on the globe, is nevertheless of high antiquity, as is proved by the great number of rocks with which it is covered. We shall not question, that sal-gem, either pure or mixed with muriatiferous clay, may have been deposited by an ancient sea; but everything evinces that it was formed during an order of things bearing no resemblance to that in which the sea at present, by a slower operation, deposits a few particles of muriate of soda on the sands of our shores. In the same manner as sulphur and coal belong to periods of formation very remote from each other, the sal-gem is also found some-times in transition gypsum,* sometimes in the Alpine lime-stone†, sometimes in a muriatiferous clay lying on a very

* Uebergangsgyps, in the transition slate of White Alley (l'Allée Blanche), and between the grauwacke and black transition limestone near Bex, below the Dent de Chamossaire, according to M. von Buch.

† At Halle in the Tyrol.

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recent sandstone*, and lastly, sometimes in a gypsum† posterior to the chalk.

The new salt-works of Araya have five reservoirs, or pits, the largest of which have two thousand three hundred square toises surface. Their mean depth is eight inches. Use is made both of the rain-water, which by filtration collects at the lowest part of the plain, and of the water of the sea, which enters by canals, or *martellières*, when the flood-tide is favoured by the winds. The situation of these new salt-works is less advantageous than that of the lagoon. The waters which fall into the latter pass over steeper slopes, washing a greater extent of ground.

The earth already lixiviated is never carried away here, as it is from time to time in the island of Margareta; nor have

* At Punta Araya.

† Gypsum of the third formation among the secondary gypsums. The first formation contains the gypsum in which are found the brine-springs of Thuringia, and which is placed either in the Alpine limestone or zechstein, to which it essentially belongs (Freiesleben, Geognost. Arbeiten, tom. ii. p. 131), or between the zechstein and the limestone of the Jura, or between the zechstein and the new sandstone. It is the ancient gypsum of secondary formation of Werner's school (älterer flözgyps), which we almost preferably call muriatiferous gypsum. The second formation is composed of fibrous gypsum, placed either in the molasse or new sandstone, or between this and the upper limestone. It abounds in common clay, which differs essentially from the salzthon or muriatiferous clay. The third formation of gypsum is more recent than chalk. To this belongs the *bony gypsum of Paris;* and, as appears from the researches of Mr. Steffens (Geogn. Aufsatsze, 1810, p. 142), the gypsum of Segeberg, in Holstein, in which sal-gem is sometimes disseminated in very small nests (Jenaische Litteratur-Zeitung, 1813, p. 100). The gypsum of Paris, lying between a cerite limestone, which covers chalk and a sandstone without shells, is distinguished by fossil bones of quadrupeds, while the Segeberg and Lunebourg gypsums, the position of which is more uncertain, are characterized by the boracits which they contain. Two other formations, far anterior to the three we have just mentioned, are the transition gypsum (übergangsgyps) of Aigle, and the primitive gypsum (urgyps) of the valley of Canaria, near Airolo. I flatter myself that I may render some service to those geologists who prefer the knowledge of positive facts to speculation on the origin of things, by furnishing them with materials from which they may generalize their ideas on the formation of rocks in both hemispheres. The relative antiquity of the formations is the principal object of a science which is to render us acquainted with the structure of the globe; that is to say, the nature of the strata which constitute the crust of our planet.

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wells been dug in the muriatiferous clay, with the view of finding strata richer in muriate of soda. The *salineros*, or salt-workers generally complain of want of rain; and in the new salt-works, it appears to me difficult to determine what quantity of salt is derived solely from the waters of the sea. The natives estimate it at a sixth of the total produce. The evaporation is extremely strong, and favoured by the constant motion of the air; so that the salt is collected in eighteen or twenty days after the pits are filled.

Though the muriate of soda is manufactured with less care in the peninsula of Araya than at the salt-works of Europe, it is nevertheless purer, and contains less of earthy muriates and sulphates. We know not whether this purity may be attributed to that portion of the salt which is furnished by the sea; for though it is extremely probable, that the quantity of salt dissolved in the waters of the ocean is nearly the same under every zone, it is not less uncertain whether the proportion between the muriate of soda, the muriate and sulphate of magnesia, and the sulphate and carbonate of lime, be equally invariable.

Having examined the salt-works, and terminated our geodesical operations, we departed at the decline of day to sleep at an Indian hut, some miles distant, near the ruins of the castle of Araya. Directing our course southward, we traversed first the plain covered with muriatiferous clay, and stripped of vegetation; then two chains of hills of sandstone, between which the lagoon is situated. Night overtook us while we were in a narrow path, bordered on one side by the sea, and on the other by a range of perpendicular rocks. The tide was rising rapidly, and narrowed the road at every step. We at length arrived at the foot of the old castle of Araya, where we enjoyed a prospect that had in it something lugubrious and romantic. The ruins stand on a bare and arid mountain, crowned with agave, columnar cactus, and thorny mimosas: they bear less resemblance to the works of man, than to those masses of rock which were ruptured at the early revolutions of the globe.

We were desirous of stopping to admire this majestic spectacle, and to observe the setting of Venus, whose disk appeared at intervals between the yawning crannies of the

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castle; but the muleteer, who served as our guide, was parched with thirst, and pressed us earnestly to return. He had long perceived that we had lost our way; and as he hoped to work on our fears he continually warned us of the danger of tigers and rattlesnakes. Venomous reptiles are, indeed, very common near the castle of Araya; and two jaguars had been lately killed at the entrance of the village of Maniquarez. If we might judge from their skins, which were preserved, their size was not less than that of the Indian tiger. We vainly represented to our guide that those animals did not attack men where the goats furnished them with abundant prey; we were obliged to yield, and return. After having proceeded three quarters of an hour along a shore covered by the tide we were joined by the negro, who carried our provision. Uneasy at not seeing us arrive, he had come to meet us, and he led us through a wood of nopals to a hut inhabited by an Indian family. We were received with the cordial hospitality observed in this country among people of every tribe. The hut in which we slung our hammocks was very clean; and there we found fish, plantains, and what in the torrid zone is preferable to the most sumptuous food, excellent water.

The next day at sunrise we found that the hut in which we had passed the night formed part of a group of small dwellings on the borders of the salt lake, the remains of a considerable village which had formerly stood near the castle. The ruins of a church were seen partly buried in the sand, and covered with brushwood. When, in 1762, to save the expense of the garrison, the castle of Araya was totally dismantled, the Indians and Mulattoes who were settled in the neighbourhood emigrated by degrees to Maniquarez, to Cariaco, and in the suburb of the Guayquerias at Cumana. A small number, bound from affection to their native soil, remained in this wild and barren spot. These poor people live by catching fish, which are extremely abundant on the coast and the neighbouring shoals. They appear satisfied with their condition, and think it strange when they are asked why they have no gardens or culinary vegetables. Our gardens, they reply, are beyond the gulf; when we carry our fish to Cumana, we bring back plantains, cocoa nuts, and cassava. This system of economy, which favours

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idleness, is followed at Maniquarez, and throughout the whole peninsula of Araya. The chief wealth of the inhabitants consists in goats, which are of a very large and very fine breed, and rove in the fields like those at the Peak of Teneriffe. They have become entirely wild, and are marked like the mules, because it would be difficult to recognize them from their colour or the arrangement of their spots. These wild goats are of a brownish yellow, and are not varied in colour like domestic animals. If in hunting, a colonist kills a goat which he does not consider as his own property, he carries it immediately to the neighbour to whom it belongs. During two days we heard it everywhere spoken of as a very extraordinary circumstance, that an inhabitant of Maniquarez had lost a goat, on which it was probable that a neighbouring family had regaled themselves.

Among the Mulattoes, whose huts surround the salt lake, we found a shoemaker of Castilian descent. He received us with the air of gravity and self-sufficiency which in those countries characterize almost all persons who are conscious of possessing some peculiar talent. He was employed in stretching the string of his bow, and sharpening his arrows to shoot birds. His trade of a shoemaker could not be very lucrative in a country where the greater part of the inhabitants go barefooted; and he only complained that, on account of the dearness of European gunpowder, a man of his quality was reduced to employ the same weapons as the Indians. He was the sage of the plain; he understood the formation of the salt by the influence of the sun and full moon, the symptoms of earthquakes, the marks by which mines of gold and silver are discovered, and the medicinal plants, which, like all the other colonists from Chile to California, he classified into *hot and cold*.* Having collected the traditions of the country, he gave us some curious accounts of the pearls of Cubagua, objects of luxury, which he treated with the utmost contempt. To show us how familiar to him were the sacred writings he took a pride in reminding us that Job preferred wisdom to all the pearls of the Indies. His philosophy was circumscribed to the narrow circle of the wants of life. The possession of a very strong ass, able

* Exciting or debilitating, the sthenic and asthenic, of Brown's system.

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to carry a heavy load of plantains to the *embarcadero*, was the consummation of all his wishes.

After a long discourse on the emptiness of human greatness, he drew from a leathern pouch a few very small opaque pearls, which he forced us to accept, enjoining us at the same time to note on our tablets that a poor shoemaker of Araya, but a white man, and of noble Castilian race, had been enabled to give us something which, on the other side of the sea,* was sought for as very precious. I here acquit myself of the promise I made to this worthy man, who disinterestedly refused to accept of the slightest retribution. The Pearl Coast presents the same aspect of misery as the countries of gold and diamonds, Choco and Brazil; but misery is not there attended with that immoderate desire of gain which is excited by mineral wealth.

The pearl-breeding oyster (Avicula margaritifera, Cuvier) abounds on the shoals which extend from Cape Paria to Cape la Vela. The islands of Margareta, Cubagua, Coche, Punta Araya, and the mouth of the Rio la Hacha, were, in the sixteenth century, as celebrated as were the Persian Gulf and the island of Taprobana among the ancients. It is incorrectly alleged by some historians that the natives of America were unacquainted with the luxury of pearls. The first Spaniards who landed in Terra Firma found the savages decked with pearl necklaces and bracelets; and among the civilized people of Mexico and Peru, pearls of a beautiful form were extremely sought after. I have published a dissertation on the statue of a Mexican priestess in basalt, whose head-dress, resembling the *calantica* of the heads of Isis, is ornamented with pearls. Las Casas and Benzoni have described, but not without some exaggeration, the cruelties which were exercised on the unhappy Indian slaves and negroes employed in the pearl fishery. At the beginning of the conquest the island of Coche alone furnished pearls amounting in value to fifteen hundred marks per month.

The *quint* which the king's officers drew from the produce of pearls, amounted to fifteen thousand ducats; which, according to the value of the precious metals in those times,

* 'Por alla,' or, 'del otro lado del charco,' (properly 'beyond,' or 'on the other side of the great lake'), a figurative expression, by which the people in the Spanish colonies denote Europe.

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and the extensiveness of contraband trade, may be regarded as a very considerable sum. It appears that till 1530 the value of the pearls sent to Europe amounted yearly on an average to more than eight hundred thousand piastres. In order to judge of the importance of this branch of commerce to Seville, Toledo, Antwerp, and Genoa, we should recollect that at the same period the whole of the mines of America did not furnish two millions of piastres; and that the fleet of Ovando was thought to contain immense wealth, because it had on board nearly two thousand six hundred marks of silver. Pearls were the more sought after, as the luxury of Asia had been introduced into Europe by two ways diametrically opposite: that of Constantinople, where the Palæologi wore garments covered with strings of pearls; and that of Grenada, the residence of the Moorish kings, who displayed at their court all the luxury of the East. The pearls of the East were preferred to those of the West; but the number of the latter which circulated in commerce was nevertheless considerable at the period immediately followed the discovery of America. In Italy as well as in Spain, the islet of Cubagua became the object of numerous mercantile speculations.

Benzoni* relates the adventure of one Luigi Lampagnano, to whom Charles the Fifth granted the privilege of proceeding with five carvels to the coasts of Cumana to fish for pearls. The colonists sent him back with this bold message: "'That the emperor was too liberal of what was not his own, and that he had no right to dispose of the oysters which live at the bottom of the sea."

The pearl fishery diminished rapidly about the end of the sixteenth century; and, according to Laet, it had long ceased in 1633.† The industry of the Venetians, who imitated fine pearls with great exactness, and the frequent use of cut

* La Hist. del Mondo Nuovo, p. 34. Luigi Lampagnano, a relation of the assassin of the Duke of Milan, Galeazzo Maria Sforza, could not pay the merchants of Seville who had advanced the money for his voyage; he remained five years at Cubagua, and died in a fit of insanity.

† "Insularum Cubaguæ et Coches quondam magna fuit dignitas, quum Unionum captura floreret: nunc, illa deficiente, obscura admodum fama." Laet, Nova Orbis, p. 669. This accurate compiler, speaking of Punta Araya, adds, this country is so forgotten, "ut vix ulla Americæ meridionalis pars hodie obscurior sit."

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diamonds,* rendered the fisheries of Cubagua less lucrative. At the same time, the oysters which yielded the pearls became scarcer, not, because, according to a popular tradition, they were frightened by the sound of the oars, and removed elsewhere; but because their propagation had been impeded by the imprudent destruction of the shells by thousands. The pearl-bearing oyster is of a more delicate nature than most of the other acephalous mollusca. At the island of Ceylon, where, in the bay of Condeatchy, the fishery employs six hundred divers, and where the annual produce is more than half a million of piastres, it has vainly been attempted to transplant the oysters to other parts of the coast. The government permits fishing there only during a single month; while at Cubagua the bank of shells was fished at all seasons. To form an idea of the destruction of the species caused by the divers, we must remember that a boat sometimes collects, in two or three weeks, more than thirty-five thousand oysters. The animal lives but nine or ten years; and it is only in its fourth year that the pearls begin to show themselves. In ten thousand shells there is often not a single pearl of value. Tradition records that on the bank of Margareta the fishermen opened the shells one by one: in the island of Ceylon, the animals are thrown into heaps to rot in the air; and to separate the pearls which are not attached to the shell, the animal pulp is washed, as miners wash the sand which contains grains of gold, tin, or diamonds.

At present Spanish America furnishes no other pearls for trade than those of the gulf of Panama, and the mouth of the Rio de la Hacha. On the shoals which surround Cubagua, Coche, and the island of Margareta, the fishery is as much neglected as on the coasts of California.† It is believed at Cumana, that the pearl-oyster has greatly multiplied after two centuries of repose; and in 1812, some new attempts were made at Margareta for the fishing of pearls. It has been asked, why the pearls found at present in shells which become entangled in the fishermen's nets are so small, and

* The cutting of diamonds was invented by Lewis de Berquen, in 1456, but the art became common only in the following century.

† I am astonished at never having heard, in the course of my travels, of pearls found in the fresh-water shells of South America, though several species of the *Unio* genus abound in the rivers of Peru.

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have so little brilliancy,* whilst, on the Spaniards' arrival, they were extremely beautiful, though the Indians doubtless had not taken the trouble of diving to collect them. The problem is so much the more difficult to solve, as we know not whether earthquakes may have altered the nature of the bottom of the sea, or whether the changes of the submarine currents may have had an influence either on the temperature of the water, or on the abundance of certain mollusca on which the Aronde feeds.

On the morning of the 20th our host's son, a young and very robust Indian, conducted us by the way of Barigon and Caney to the village of Maniquarez, which was four hours' walk. From the effect of the reverberation of the sands, the thermometer kept up to 31° 3′. The cylindric cactus, which bordered the road, gave the landscape an appearance of verdure, without affording either coolness or shade. Before our guide had walked a league, he began to sit down every moment, and at length he wished to repose under the shade of a fine tamarind tree near Casas de la Vela, to await the approach of night. This characteristic trait, which we observed every time we travelled with Indians, has given rise to very erroneous ideas of the physical constitutions of the different races of men. The copper-coloured native, more accustomed to the burning heat of the climate, than the European traveller, complains more, because he is stimulated by no interest. Money is without attraction for him; and if he permits himself to be tempted by gain for a moment, he repents of his resolution as soon as he is on the road. The same Indian, who would complain, when in herborizing we loaded him with a box filled with plants, would row his canoe fourteen or fifteen hours together, against the strongest current, because he wished to return to his family. In order to form a true judgment of the muscular strength of the people, we should observe them in circumstances where their actions are determined by a necessity and a will equally energetic.

We examined the ruins of Santiago,† the structure of

* The inhabitants of Araya sometimes sell these small pearls to the retail dealers of Cumana. The ordinary price is one piastre per dozen.

† On the map accompanying Robertson's History of America, we find the name of this castle confounded with that of Nueva Cordoba.

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which is remarkable for its extreme solidity. The walls of freestone, five feet thick, have been blown up by mines; but we still found masses of seven or eight hundred feet square, which have scarcely a crack in them. Our guide showed us a cistern (aljibe) thirty feet deep, which, though much damaged, furnishes water to the inhabitants of the peninsula of Araya. This cistern was finished in 1681, by the governor Don Juan de Padilla Guardiola, the same who built at Cumana the small fort of Santa Maria. As the basin is covered with an arched vault, the water, which is of excellent quality, keeps very cool: the confervæ, while they decompose the carburetted hydrogen, also shelter worms which hinder the propagation of small insects. It had been believed for ages, that the peninsula of Araya was entirely destitute of springs of fresh water; but in 1797, after many useless researches, the inhabitants of Maniquarez succeeded in discovering some.

In crossing the arid hills of Cape Cirial, we perceived a strong smell of petroleum. The wind blew from the direction in which the springs of this substance are found, and which were mentioned by the first historians of these countries.* Near the village of Maniquarez, the mica-slate† comes out from below the secondary rock, forming a chain of mountains from one hundred and fifty to one hundred and eighty toises in height. The direction of the primitive rock near Cape Sotto is from north-east to south-west; its strata incline fifty degrees to the north-west. The mica-slate is silvery white, of lamellar and undulated texture, and contains garnets. Strata of quartz, the thickness of which varies from three to four toises, traverse the mica-slate, as we may observe in several ravines hollowed out by the waters. We detached with difficulty a fragment of cyanite from a block of splintered and milky quartz, which was isolated on the shore. This was the only time we found this substance in South America.‡

This latter denomination was formerly synonymous with Cumana.—Herrera, p. 14.

* Oviedo, terms it "A resinous, aromatic, and medicinal liquor."

† The Piedra pelada of the Creoles.

‡ In New Spain, the cyanite has been discovered only in the province of Guatimala, at Estancia Grande,—Del Rio, Tablas Min., 1804, p. 27.

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The potteries of Maniquarez, celebrated from time immemorial, form a branch of industry which is exclusively in the hands of the Indian women. The manufacture is still carried on according to the method used before the conquest. It indicates both the infancy of the art, and that unchangeability of manners which is characteristic of all the natives of America. Three centuries have been insufficient to introduce the potter's-wheel, on a coast which is not above thirty or forty days' sail from Spain. The natives have some confused notions with respect to the existence of this machine, and they would no doubt make use of it if it were introduced among them. The quarries whence they obtain the clay are half a league to the east of Maniquarez. This clay is produced by natural decomposition of a mica-slate reddened by oxide of iron. The Indian women prefer the part most abounding in mica; and with great skill fashion vessels two or three feet in diameter, giving them a very regular curve. As they are not acquainted with the use of ovens, they place twigs of desmanthus, cassia, and the arborescent capparis, around the pots, and bake them in the open air. To the east of the quarry which furnishes the clay is the ravine of La Mina. It is asserted, that, a short time after the conquest, some Venetians extracted gold from the mica-slate. It appears, that this metal was not collected in veins of quartz, but was found disseminated in the rock, as it is sometimes in granite and gneiss.

At Maniquarez we met with some creoles, who had been hunting at Cubagua. Deer of a small breed are so common in this uninhabited islet, that a single individual may kill three or four in a day. I know not by what accident these animals have got thither, for Laet and other chroniclers of these countries, speaking of the foundation of New Cadiz, mention only the great abundance of rabbits. The *venado* of Cubagua belongs to one of those numerous species of small American deer, which zoologists have long confounded under the vague name of Cervus mexicanus. It does not appear to be the same as the hind of the savannahs of Cayenne, or the *guazuti* of Paraguay, which live also in herds. Its colour is a brownish red on the back, and white under the belly; and it is spotted like the axis. In the plains of Cari we were shown, as a thing very rare in these hot

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climates, a variety quite white. It was a female of the size of the roebuck of Europe, and of a very elegant shape. White varieties are found in the New Continent even among the tigers. Azara saw a jaguar, the skin of which was wholly white, with merely the shadow, as it might be termed, of a few circular spots.

Of all the productions on the coasts of Araya, that which the people consider as the most extraordinary, or we may say the most marvellous, is 'the stone of the eyes,' (*piedra de los ojos.*) This calcareous substance is a frequent subject of conversation: being, according to the natural philosophy of the natives, both a stone and an animal. It is found in the sand, where it is motionless; but if placed on a polished surface, for instance on a pewter or earthern plate, it moves when excited by lemon juice. If placed in the eye, the supposed animal turns on itself, and expels every other foreign substance that has been accidentally introduced. At the new salt-works, and at the village of Maniquarez, these *stones of the eyes** were offered to us by hundreds, and the natives were anxious to show us the experiment of the lemon juice. They even wished to put sand into our eyes, in order that we might ourselves try the efficacy of the remedy. It was easy to see that the stones are thin and porous opercula, which have formed part of small univalve shells. Their diameter varies from one to four lines. One of their two surfaces is plane, and the other convex. These calcareous opercula effervesce with lemon juice, and put themselves in motion in proportion as the carbonic acid is disengaged. By the effect of a similar reaction, loaves placed in an oven move sometimes on a horizontal plane; a phenomenon that has given occasion, in Europe, to the popular prejudice of *enchanted ovens*. The *piedras de los ojos*, introduced into the eye, act like the small pearls, and different round grains employed by the American savages to increase the flowing of tears. These explanations were little to the taste of the inhabitants of Araya. Nature has the appearance of greatness to man in proportion as she is veiled in mystery; and the ignorant are prone to put faith in everything that borders on the marvellous.

* They are found in the greatest abundance near the battery at the point of Cape Araya.

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Proceeding along the southern coast, to the east of Maniquarez, we find running out into the sea very near each other, three strips of land, bearing the names of Punta de Soto, Punta de la Brea, and Punta Guaratarito. In these parts the bottom of the sea is evidently formed of mica-slate, and from it near Cape de la Brea, but at eighty feet distant from the shore, there issues a spring of naphtha, the smell of which penetrates into the interior of the peninsula. It is necessary to wade into the sea up to the waist, to examine this interesting phenomenon. The waters are covered with zostera; and in the midst of a very extensive bank of weeds, we distinguish a free and circular spot of three feet in diameter, on which float a few scattered masses of Ulva lactuca. Here the springs are found. The bottom of the gulf is covered with sand; and the petroleum, which, from its transparency and its yellow colour, resembles naphtha, rises in jets, accompanied by air bubbles. On treading down the bottom with the foot, we perceive that these little springs change their place. The naphtha covers the surface of the sea to more than a thousand feet distant. If we suppose the dip of the strata to be regular, the mica-slate must be but a few toises below the sand.

We have already observed, that the muriatiferous clay of Araya contains solid and friable petroleum. This geological connection between the muriate of soda and the bitumens is evident wherever there are mines of sal-gem or salt springs: but a very remarkable fact is the existence of a fountain of naphtha in a primitive formation. All those hitherto known belong to secondary mountains;* a circumstance which has been supposed to favour the idea that all mineral bitumens are owing to the destruction of vegetables and animals, or to the burning of coal. In the peninsula of Araya, the naphtha flows from the primitive rock itself; and this phenomenon acquires new importance, when we recollect that the same primitive rocks contain the subterranean fires, that on the brink of burning craters the smell of petroleum is perceived from time to time, and that the greater part of the hot springs of America rise from gneiss and micaceous schist.

* As at Pietra Mala; Fanano; Mont Zibio; and Amiano (in these places are found the springs that furnish the naphtha burned in lamps in Genoa); and also at Baikal.

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After having examined the environs of Maniquarez, we embarked at night in a fishing-boat for Cumana. The small crazy boats employed by the natives here, bear testimony to the extreme calmness of the sea in these regions. Our boat, though the best we could procure, was so leaky, that the pilot's son was constantly employed in baling out the water with a *tutuma*, or shell of the Crescentia cujete (calabash). It often happens in the gulf of Cariaco, and especially to the north of the peninsula of Araya, that canoes laden with cocoa-nuts are upset in sailing too near the wind, and against the tide.

The inhabitants of Araya, whom we visited a second time on returning from the Orinoco, have not forgotten that their peninsula was one of the points first peopled by the Spaniards. They love to talk of the pearl fishery; of the ruins of the castle of Santiago, which they hope to see some day rebuilt; and of everything that recalls to mind the ancient splendour of those countries. In China and Japan those inventions are considered as recent, which have not been known above two thousand years; in the European colonies an event appears extremely old, if it dates back three centuries, or about the period of the discovery of America.

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Chapter VI.

Mountains of New Andalusia.—Valley of Cumanacoa.—Summit of the Cocollar.—Missions of the Chayma Indians.

Our first visit to the peninsula of Araya was soon succeeded by an excursion to the mountains of the missions of the Chayma Indians, where a variety of interesting objects claimed our attention. We entered on a country studded with forests, and visited a convent surrounded by palm-trees and arborescent ferns. It was situated in a narrow valley, where we felt the enjoyment of a cool and delicious climate, in the centre of the torrid zone. The surrounding mountains contain caverns haunted by thousands of nocturnal birds; and, what affects the imagination more than all the wonders of the physical world, we find beyond these mountains a people lately nomade, and still nearly in a state of nature, wild without being barbarous. It was in the promontory of Paria that Columbus first descried the continent; there terminate these valleys, laid waste alternately by the warlike anthropophagic Carib and by the commercial and polished nations of Europe. At the beginning of the sixteenth century the ill-fated Indians of the coasts of Carupano, of Macarapan, and of Caracas, were treated in the same manner as the inhabitants of the coast of Guinea in our days. The soil of the islands was cultivated, the vegetable produce of the Old World was transplanted thither, but a regular system of colonization remained long unknown on the New Continent. If the Spaniards visited its shores, it was only to procure, either by violence or exchange, slaves, pearls, grains of gold, and dye-woods; and endeavours were made to ennoble the motives of this insatiable avarice by the pretence of enthusiastic zeal in the cause of religion.

The trade in the copper-coloured Indians was accompanied by the same acts of inhumanity as that which characterizes the traffic in African negroes; it was attended also by the same result, that of rendering both the conquerors and the conquered more ferocious. Thence wars became more frequent

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among the natives; prisoners were dragged from the inland countries to the coast, to be sold to the whites, who loaded them with chains in their ships. Yet the Spaniards were at that period, and long after, one of the most polished nations of Europe. The light which art and literature then shed over Italy, was reflected on every nation whose language emanated from the same source as that of Dante and Petrarch. It might have been expected that a general improvement of manners would be the natural consequence of this noble awakening of the mind, this sublime soaring of the imagination. But in distant regions, wherever the thirst of wealth has introduced the abuse of power, the nations of Europe, at every period of their history, have displayed the same character. The illustrious era of Leo X was signalized in the New World by acts of cruelty that seemed to belong to the most barbarous ages. We are less surprised, however, at the horrible picture presented by the conquest of America when we think of the acts that are still perpetrated on the western coast of Africa, notwithstanding the benefits of a more humane legislation.

The principles adopted by Charles V. had abolished the slave trade on the New Continent. But the Conquistadores, by the continuation of their incursions, prolonged the system of petty warfare which diminished the American population, perpetuated national animosities, and during a long period crushed the seeds of rising civilization. At length the missionaries, under the protection of the secular arm, spoke words of peace. It was the privilege of religion to console humanity for a part of the evils committed in its name; to plead the cause of the natives before kings, to resist the violence of the commendataries, and to assemble wandering tribes into small communities called Missions.

But these institutions, useful at first in stopping the effusion of blood, and in laying the first basis of society, have become in their result hostile to its progress. The effects of this insulated system have been such that the Indians have remained in a state little different from that in which they existed whilst yet their scattered dwellings were not collected round the habitation of a missionary. Their number has considerably augmented, but the sphere of their ideas is not enlarged. They have progressively lost that

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vigour of character and that natural vivacity which in every state of society are the noble fruits of independence. By subjecting to invariable rules even the slightest actions of their domestic life, they have been rendered stupid by the effort to render them obedient. Their subsistence is in general more certain, and their habits more pacific, but subject to the constraint and the dull monotony of the government of the Missions, they show by their gloomy and reserved looks that they have not sacrificed their liberty to their repose without regret.

On the 4th of September, at five in the morning, we began our journey to the Missions of the Chayma Indians and the group of lofty mountains which traverse New Andalusia. On account of the extreme difficulties of the road, we had been advised to reduce our baggage to a very small bulk. Two beasts of burden were sufficient to carry our provision, our instruments, and the paper necessary to dry our plants. One chest contained a sextant, a dipping-needle, an apparatus to determine the magnetic variation, a few thermometers, and Saussure's hygrometer. The greatest changes in the pressure of the air in these climates, on the coasts, amount only to 1—1·3 of a line; and if at any given hour or place the height of the mercury be once marked, the variations which that height experiences throughout the whole year, at every hour of the day or night, may with some accuracy be determined.

The morning was deliciously cool. The road, or rather path, which leads to Cumanacoa, runs along the right bank of the Manzanares, passing by the hospital of the Capuchins, situated in a small wood of lignum-vitæ and arborescent capparis.* On leaving Cumana we enjoyed during the short duration of the twilight, from the top of the hill of San Francisco, an extensive view over the sea, the plain covered with bera† and its golden flowers, and the mountains of the Brigantine. We were struck by the great proximity in

* These caper-trees are called in the country, by the names pachaca, olivo, and ajito: they are the Capparis tenuisiliqua, Jacq., C. ferruginea, C. emarginata, C. elliptica, C. reticulata, C. racemosa.

† Palo sano, Zygophyllum arboreum, Jacq. The flowers have the smell of vanilla. It is cultivated in the gardens of the Havannah under the strange name of the *dictanno real* (royal dittany).

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which the Cordillera appeared before the disk of the rising sun had reached the horizon. The tint of the summits is of a deeper blue, their outline is more strongly marked, and their masses are more detached, as long as the transparency of the air is undisturbed by the vapours, which, after accumulating during the night in the valleys, rise in proportion as the atmosphere acquires warmth.

At the hospital of the Divina Pastora the path turns to north-east, and stretches for two leagues over a soil without trees, and formerly levelled by the waters. We there found not only cactuses, tufts of cistus-leaved tribulus, and the beautiful purple euphorbia,* but also the avicennia, the alhonia, the sesuvium, the thalinum, and most of the portulaceous plants which grow on the banks of the gulf of Cariaco. This geographical distribution of plants appears to designate the limits of the ancient coast, and to prove that the hills along the southern side of which we were passing, formed heretofore a small island, separated from the continent by an arm of the sea.

After walking two hours, we arrived at the foot of the high chain of the interior mountains, which stretches from east to west; from the Brigantine to the Cerro de San Lorenzo. There, new rocks appear, and with them another aspect of vegetation. Every object assumes a more majestic and picturesque character; the soil, watered by springs, is furrowed in every direction; trees of gigantic height, covered with lianas, rise from the ravines; their bark, black and burnt by the double action of the light and the oxygen of the atmosphere, contrasts with the fresh verdure of the pothos and dracontium, the tough and shining leaves of which are sometimes several feet long. The parasite monocotyledons take between the tropics the place of the moss and lichens of our northern zone. As we advanced, the forms and grouping of the rocks reminded us of Switzerland and the Tyrol. The heliconia, costus, maranta, and other plants of the family of the balisiers (Canna indica), which near the coasts vegetate only in damp and low places, flourish in the American Alps at considerable height. Thus, by a singular similitude, in the torrid zone, under the influence of an atmosphere continually loaded with vapours

* Euphorbia tithymaloides.

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the mountain vegetation presents the same features as the vegetation of the marshes in the north of Europe on soil moistened by melting snow.*

Before we leave the plains of Cumana, and the breccia, or calcareous sandstone, which constitutes the soil of the sea-side, we will describe the different strata of which this very recent formation is composed, as we observed it on the back of the hills that surround the castle of San Antonio.

The breccia, or calcareous sandstone, is a local and partial formation, peculiar to the peninsula of Araya, the coasts of Cumana, and Caracas. We again found it at Cabo Blanco, to the west of the port of Guayra, where it contains, besides broken shells and madrepores, fragments, often angular, of quartz and gneiss. This circumstance assimilates the breccia to that recent sandstone called by the German mineralogists *nagelfluhe*, which covers so great a part of Switzerland to the height of a thousand toises, without presenting any trace of marine productions. Near Cumana the formation of the calcareous breccia contains:—1st, a compact whitish grey limestone, the strata of which, sometimes horizontal, sometimes irregularly inclined, are from five to six inches thick; some beds are almost unmixed with petrifactions, but in the greatest part the cardites, the turbinites, the ostracites, and shells of small dimension, are found so closely connected, that the calcareous matter forms only a cement, by which the grains of quartz and the organized bodies are united: 2dly, a calcareous sandstone, in which the grains of sand are much more frequent than the petrified shells; other strata form a sandstone entirely free from organic fragments, yielding but a small effervescence with acids, and enclosing not lamellæ of mica, but nodules of compact brown iron-ore: 3d, beds of indurated clay containing selenite and lamellar gypsum.

The breccia, or agglomerate of the sea-coast, just described, has a white tint, and it lies immediately on the calcareous formation of Cumanacoa, which is of a bluish grey. These two rocks form a contrast no less striking than the molasse (bur-stone) of the Pays de Vaud, with the calcareous limestone of the Jura. It must be observed, that, by contact of

* Wahlenberg, de Vegetatione Helvetiæ, et summi Septentrionis, pp. 47, 59.

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the two formations lying upon each other, the beds of the limestone of Cumanacoa, which I consider as an Alpine limestone, are always largely mixed with clay and marl. Lying, like the mica-slate of Araya, north-east and south-west, they are inclined, near Punta Delgada, under an angle of 60 degrees to south-east.

We traversed the forest by a narrow path, along a rivulet, which rolls foaming over a bed of rocks. We observed, that the vegetation was more brilliant, wherever the Alpine limestone was covered by a quartzose sandstone without petrifactions, and very different from the breccia of the sea-coast. The cause of this phenomenon depends probably not so much on the nature of the ground, as on the greater humidity of the soil. The quartzose sandstone contains thin strata of a blackish clay-slate,* which might easily be confounded with the secondary *thonschiefer;* and these strata hinder the water from filtering into the crevices, of which the Alpine limestone is full. This last offers to view here, as in Saltzburg, and on the chain of the Apennines, broken and steep beds. The sandstone, on the contrary, wherever it is seated on the calcareous rock, renders the aspect of the scene less wild. The hills which it forms appear more rounded, and the gentler slopes are covered with a thicker mould.

In humid places, where the sandstone envelopes the Alpine limestone, some trace of cultivation is constantly found. We met with huts inhabited by mestizoes in the ravine of Los Frailes, as well as between the Cuesta de Caneyes, and the Rio Guriental. Each of these huts stands in the centre of an enclosure, containing plantains, papaw-trees, sugar-canes, and maize. We might be surprised at the small extent of these cultivated spots, if we did not recollect that an acre planted with plantains† produces nearly twenty times as much food as the some space sown with corn. In Europe, our wheat, barley, and rye cover vast spaces of ground; and in general the arable lands touch each other, wherever the inhabitants live upon corn. It is different under the torrid zone, where man obtains food from plants which yield more abundant and earlier harvests. In those favoured climes, the fertility of the soil is proportioned to the heat and humidity of the atmosphere. An immense population finds

* Schieferthon. † Musa paradisiaca.

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abundant nourishment within a narrow space, covered with plantains, cassava, yams, and maize. The isolated situation of the huts dispersed through the forest indicates to the traveller the fecundity of nature, where a small spot of cultivated land suffices for the wants of several families.

These considerations on the agriculture of the torrid zone involuntarily remind us of the intimate connexion existing between the extent of land cleared, and the progress of society. The richness of the soil, and the vigour of organic life, by multiplying the means of subsistence, retard the progress of nations in the paths of civilization. Under so mild and uniform a climate, the only urgent want of man is that of food. This want only, excites him to labour; and we may easily conceive why, in the midst of abundance, beneath the shade of the plantain and bread-fruit tree, the intellectual faculties unfold themselves less rapidly than under a rigourous sky, in the region of corn, where our race is engaged in a perpetual struggle with the elements. In Europe we estimate the number of the inhabitants of a country by the extent of cultivation: within the tropics, on the contrary, in the warmest and most humid parts of South America, very populous provinces appear almost deserted; because man, to find nourishment, cultivates but a small number of acres. These circumstances modify the physical appearance of the country and the character of its inhabitants, giving to both a peculiar physiognomy; the wild and uncultivated stamp which belongs to nature, ere its primitive type has been altered by art. Without neighbours, almost unconnected with the rest of mankind, each family of settlers forms a separate tribe. This insulated state arrests or retards the progress of civilization, which advances only in proportion as society becomes numerous, and its connexions more intimate and multiplied. But, on the other hand, it is solitude that developes and strengthens in man the sentiment of liberty and independence; and gives birth to that noble pride of character which has at all times distinguished the Castilian race.

From these causes, the land in the most populous regions of equinoctial America still retains a wild aspect, which is destroyed in temperate climates by the cultivation of corn. Within the tropics the agricultural nations occupy less

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ground: man has there less extended his empire; he may be said to appear, not as an absolute master, who changes at will the surface of the soil, but as a transient guest, who quietly enjoys the gifts of nature. There, in the neighbourhood of the most populous cities, the land remains studded with forests, or covered with a thick mould, unfurrowed by the plough. Spontaneous vegetation still predominates over cultivated plants, and determines the aspect of the landscape. It is probable that this state of things will change very slowly. If in our temperate regions the cultivation of corn contributes to throw a dull uniformity upon the land we have cleared, we cannot doubt, that, even with increasing population, the torrid zone will preserve that majesty of vegetable forms, those marks of an unsubdued, virgin nature, which render it so attractive and so picturesque. Thus it is that, by a remarkable concatenation of physical and moral causes, the choice and production of alimentary plants have an influence on three important objects at once; the association or the isolated state of families, the more or less rapid progress of civilization, and the individual character of the landscape.

In proportion as we penetrated into the forest, the barometer indicated the progressive elevation of the land. The trunks of the trees presented here an extraordinary phenomenon; a gramineous plant, with verticillate branches,* climbs, like a liana, eight or ten feet high, and forms festoons, which cross the path, and swing about with the wind. We halted, about three o'clock in the afternoon, on a small flat, known by the name of Quetepe, and situated about one hundred and ninety toises above the level of the sea. A few small houses have been erected near a spring, well known by the natives for its coolness and great salubrity. We found the water delicious. Its temperature was only 22·5° of the centigrade thermometer, while that of the air was 28·7°. The springs which descend from the neighbouring mountains of a greater height often indicate a too rapid decrement of heat. If indeed we suppose the mean temperature of the water on the coast of Cumana equal to 26°, we must conclude, unless other local causes modify the temperature of the

* *Carrée*, analogous to the *chusque* of Santa Fé, of the group of the Nastuses. This gramineous plant is excellent pasture for mules.

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springs, that the spring of Quetepe acquires its great coolness at more than 350 toises of absolute elevation. With respect to the springs which gush out in the plains of the torrid zone, or at a small elevation, it may be observed, in general, that it is only in regions where the mean temperature of summer essentially differs from that of the whole year, that the inhabitants have extremely cold spring water during the season of great heat. The Laplanders, near Umea and Sœrsele, in the 65th degree of latitude, drink spring-water, the temperature of which, in the month of August, is scarcely two or three degrees above freezing point; while during the day the heat of the air rises in the shade, in the same northern regions, to 26 or 27 degrees. In the temperate climates of France and Germany, the difference between the air and the springs never exceeds 16 or 17 degrees; between the tropics it seldom rises to 5 or 6 degrees. It is easy to account for these phenomena, when we recollect that the interior of the globe, and the subterraneous waters, have a temperature almost identical with the annual mean temperature of the air; and that the latter differs from the mean heat of summer, in proportion to the distance from the equator.

From the top of a hill of sandstone, which overlooks the spring of Quetepe, we had a magnificent view of the sea, of cape Macanao, and the peninsula of Maniquarez. At our feet an immense forest extended to the edge of the ocean. The tops of the trees, intertwined with lianas, and crowned with long wreaths of flowers, formed a vast carpet of verdure, the dark tint of which augmented the splendour of the aerial light. This picture struck us the more forcibly, as we then first beheld those great masses of tropical vegitation. On the hill of Quetepe, at the foot of the Malpighia cocollobæfolia, the leaves of which are extremely coriaceous, we gathered, among tufts of the Polygala montana, the first melastomas, especially that beautiful species described under the name of the Melastoma rufescens.

As we advanced toward the south-west, the soil became dry and sandy. We climed a group of mountains, which separate the coast from the vast plains, or savannahs, bordered by the Orinoco. That part of the group, over which passes the road to Cumanacoa, is destitute of vegetation, and has steep declivities both on the north and the south.

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It has received the name of the *Imposible*, because it is believed that, in the case of hostile invasion, this ridge of mountains would be inaccessible to the enemy, and would offer an asylum to the inhabitants of Cumana. We reached the top a little before sunset, and I had scarcely time to take a few horary angles, to determine the longitude of the place by means of the chronometer.

The view from the Imposible is finer and more extensive than that from the table-land of Quetepe. We distinguished clearly by the naked eye the flattened top of the Brigantine (the position of which it would be important to fix accurately), the *embarcadero* or landing-place, and the roadstead of Cumana. The rocky coast of the peninsula of Araya was discernible in its whole length. We were particularly struck with the extraordinary configuration of a port, known by the name of Laguna Grande, or Laguna del Obispo. A vast basin, surrounded by high mountains, communicates with the gulf of Cariaco by a narrow channel which admits only of the passage of one ship at a time. This port is capable of containing several squadrons at once. It is an uninhabited place, but annually frequented by vessels, which carry mules to the West India Islands. There are some pasture grounds at the farther end of the bay. We traced the sinuosities of this arm of the sea, which, like a river, has dug a bed between perpendicular rocks destitute of vegetation. This singular prospect reminded us of the fanciful landscape which Leonardo da Vinci has made the back-ground of his famous portrait of Mona Lisa, the wife of Francisco del Giacondo.

We could observe by the chronometer the moment when the disk of the sun touched the horizon of the sea. The first contact was at $6^h\ 8'\ 13''$; the second, at $6^h\ 10'\ 26''$, mean time. This observation, which is not unimportant for the theory of terrestrial refractions, was made on the summit of the mountain, at the absolute height of 296 toises. The setting of the sun was attended by a very rapid cooling of the air. Three minutes after the last apparent contact of the disk with the horizon of the sea, the thermometer suddenly fell from 25·2° to 21·3°. Was this extraordinary refrigeration owing to some descending current? The air was however calm, and no horizontal wind was felt.

We passed the night in a house where there was a military

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post consisting of eight men, under the command of a Spanish serjeant. It was an hospital, built by the side of a powder-magazine. When Cumana, after the capture of Trinidad by the English, in 1797, was threatened with an attack, many of the inhabitants fled to Cumanacoa, and deposited whatever articles of value they possessed in sheds hastily constructed on the top of the Imposible. It was then resolved, in case of any unforeseen invasion, to abandon the castle of San Antonio, after a short resistance, and to concentrate the whole force of the province round the mountains, which may be considered as the key of the Llanos.

The top of the Imposible, as nearly as I could perceive, is covered with a quartzose sandstone, free from petrifactions. Here, as on the ridge of the neighbouring mountains, the strata pretty regularly take the direction from N. N. E. to S. S. W. This direction is also most common in the primitive formations in the peninsula of Araya, and along the coasts of Venezuela. On the northern declivity of the Imposible, near the Peñas Negras, an abundant spring issues from sandstone, which alternates with a schistose clay. We remarked on this point fractured strata, which lie from N.W. to S. E., and the dip of which is almost perpendicular.

The *Llaneros*, or inhabitants of the plains, send their produce, especially maize, leather, and cattle, to the port of Cumana by the road over the Imposible. We continually saw mules arrive, driven by Indians or mulattoes. Several parts of the vast forests which surround the mountain, had taken fire. Reddish flames, half enveloped in clouds of smoke, presented a very grand spectacle. The inhabitants set fire to the forests, to improve the pasturage, and to destroy the shrubs that choke the grass. Enormous conflagrations, too, are often caused by the carelessness of the Indians, who neglect, when they travel, to extinguish the fires by which they have dressed their food. These accidents contribute to diminish the number of old trees in the road from Cumana to Cumanacoa; and the inhabitants observe justly, that, in several parts of their province, the dryness has increased, not only because every year the frequency of earthquakes causes more crevices in the soil; but also because it is now less thickly wooded than it was at the time of the conquest.

I arose during the night to determine the latitude of the

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place by the passage of Fomalhaut over the meridian; but the observation was lost, owing to the time I employed in taking the level of the artificial horizon. It was midnight, and I was benumbed with cold, as were also our guides: yet the thermometer kept at 19·7°. At Cumana I have never seen it sink below 21°; but then the house in which we dwelt on the Imposible was 258 toises above the level of the sea. At the Casa de la Polvora I determined the dip of the magnetic needle, which was 42·5°.* The number of oscillations correspondent to 10′ of time was 233. The intensity of the magnetic forces had consequently augmented from the coast to the mountain, perhaps from the influence of some ferruginous matter, hidden in the strata of sandstone which cover the Alpine limestone.

We left the Imposible on the 5th of September before sunrise. The descent is very dangerous for beasts of burden; the path being in general but fifteen inches broad, and bordered by precipices. In descending the mountain, we observed the rock of Alpine limestone reappearing under the sandstone. The strata being generally inclined to the south and south-east, a great number of springs gush out on the southern side of the mountain. In the rainy season of the year, these springs form torrents, which descend in cascades, shaded by the hura, the cuspa, and the silver-leaved cecropia or trumpet-tree.

The cuspa, a very common tree in the environs of Cumana and of Bordones, is yet unknown to the botanists of Europe. It was long used only for the building of houses, and has become celebrated since 1797, under the name of the cascarilla or bark-tree (cinchona) of New Andalusia. Its trunk rises scarcely above fifteen or twenty feet. Its alternate leaves are smooth, entire, and oval.† Its bark very thin, and of a pale yellow, is a powerful febrifuge. It is even more bitter than the bark of the real cinchona, but is less disagreeable. The cuspa is administered with the greatest success, in a spirituous tincture, and in aqueous infusion, both in intermittent and in malignant fevers.

* The magnetic dip is always measured in this work, according to the centesimal division, if the contrary be not expressly mentioned.

† At the summit of the boughs, the leaves are sometimes opposite to each other, but invariably without stipules.

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On the coasts of New Andalusia, the cuspa is considered as a kind of cinchona; and we were assured, that some Aragonese monks, who had long resided in the kingdom of New Grenada, recognised this tree from the resemblance of its leaves to those of the real Peruvian-bark tree. This, however, is unfounded; since it is precisely by the disposition of the leaves, and the absence of stipules, that the cuspa differs totally from the trees of the rubiaceous family. It may be said to resemble the family of the honeysuckle, or caprifoliaceous plants, one section of which has alternate leaves, and among which we find several cornel-trees, remarkable for their febrifuge properties.*

The taste, at once bitter and astringent, and the yellow colour of the bark led to the discovery of the febrifugal virtue of the cuspa. As it blossoms at the end of November, we did not see it in flower, and we know not to what genus it belongs; and I have in vain for several years past applied to our friends at Cumana for specimens of the flower and fruit. I hope that the botanical determination of the bark-tree of New Andalusia will one day fix the attention of travellers, who visit this region after us; and that they will not confound, notwithstanding the analogy of the names, the cuspa with the cuspare. The latter not only vegetates in the missions of the Rio Carony, but also to the west of Cumana, in the gulf of Santa Fé. It furnishes the druggists of Europe with the famous Cortex Angosturæ, and forms the genus Bonplandia, described by M. Willdenouw in the Memoirs of the Academy of Berlin, from notes communicated to him by us.

It is singular that, during our long abode on the coast of Cumana and the Caracas, on the banks of the Apure, the Orinoco, and the Rio Negro, in an extent of country comprising forty thousand square leagues, we never met with one of those numerous species of cinchona, or exostema, which are peculiar to the low and warm regions of the tropics, especially to the archipelago of the West India Islands. Yet we are far from affirming, that, throughout the whole of the eastern part of South America, from Porto Bello to Cayenne,

* Cornus florida, and C. sericea of the United States.—Walker on the Virtues of the Cornus and the Cinchona compared. Philadelphia, 1803.

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or from the equator to the 10th degree of north latitude between the meridians of 54 and 71 degrees, the cinchona absolutely does not exist. How can we be expected to know completely the flora of so vast an extent of country? But, when we recollect, that even in Mexico no species of the genera cinchona and exostema has been discovered, either in the central table-land or in the plains, we are led to believe, that the mountainous islands of the West Indies and the Cordillera of the Andes have peculiar floras; and that they possess particular species of vegetation, which have neither passed from the islands to the continent, nor from South America to the coasts of New Spain.

It may be observed farther, that, when we reflect on the numerous analogies which exist between the properties of plants and their external forms, we are surprised to find qualities eminently febrifuge in the bark of trees belonging to different genera, and even different families.* Some of

* It may be somewhat interesting to chemistry, physiology, and descriptive botany, to consider under the same point of view the plants which have been employed in intermittent fevers with different degrees of success. We find among rubiaceous plants, besides the cinchonas and exostemas, the Coutarea speciosa or Cayenne bark, the Portlandia grandiflora of the West Indies, another portlandia discovered by M. Sesse at Mexico, the Pinkneia pubescens of the United States, the berry of the coffee-tree, and perhaps the Macrocnemum corymbosum, and the Guettarda coccinea; among magnoliaceous plants, the tulip-tree and the Magnolia glauca; among zanthoxylaceous plants, the Cuspare of Angostura, known in America under the name of Orinoco bark, and the Zanthoxylon caribæum; among leguminous plants, the geoffræas, the Swietenia febrifuga, the Æschynomene grandiflora, the Cæsalpinea bonducella; among caprifoliaceous plants, the Cornus florida and the Cuspa of Cumana; among rosaceous plants, the Cerasus virginiana and the Geum urbanum; among amentaceous plants, the willows, oaks, and birch-trees, of which the alcoholic tincture is used in Russia by the common people; the Populus tremuloides, &c.; among anonaceous plants, the Uvaria febrifuga, the fruit of which we saw administered with success in the Missions of Spanish Guiana; among simarubaceous plants, the Quassia amara, celebrated in the feverish plains of Surinam; among terebinthaceous plants, the Rhus glabrum; among euphorbiaceous plants, the Croton cascarilla; among composite plants, the Eupatorium perfoliatum, the febrifuge qualities of which are known to the savages of North America. Of the tulip-tree and the quassia, it is the bark of the roots that is used. Eminent febrifuge virtue have also been found in the cortical part of the roots of the Cinchona condaminea at Loxa; but it is fortunate, for the preservation of the species,

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these barks so much resemble each other, that it is not easy to distinguish them at first sight. But before we examine the question, whether we shall one day discover, in the real cinchona, in the cuspa of Cumana, the Cortex Angosturæ, the Indian swietenia, the willows of Europe, the berries of the coffee-tree and uvaria, a matter uniformly diffused, and exhibiting (like starch, caoutchouc, and camphor) the same chemical properties in different plants, we may ask whether, in the present state of physiology and medicine, a febrifuge principle ought to be admitted. Is it not probable, that the particular derangement in the organization, known under the vague name of the febrile state, and in which both the vascular and the nervous systems are at the same time attacked, yields to remedies which do not operate by the same principle, by the same mode of action on the same organs, by the same play of chemical and electrical attractions? We shall here confine ourselves to this observation, that, in the species of the genus cinchona, the antifebrile virtues do not appear to belong to the tannin (which is only accidentally mingled in them), or to the cinchonate of lime; but in a resiniform matter, soluble both by alcohol and by water, and which, it is believed, is composed of two principles, the cinchonic bitter and the cinchonic red.* May it then be admitted, that this resiniform matter, which possesses different degrees of energy according to the combinations by which it is modified, is found in all febrifuge substances? Those by which the sulphate of iron is precipitated of a green colour, like the real cinchona, the bark of the white willow, and the horned perisperm of the coffee-tree, do not on this account denote identity of chemical composition;† and that identity might even exist, without our concluding that the medical virtues were analogous. We see that

that the roots of the real cinchona are not employed in pharmacy. Chemical researches are yet wanting upon the very powerful bitters contained in the roots of the Zanthoriza apiifolia, and the Actæa racemosa: the latter have sometimes been employed with success as a remedy against the epidemic yellow fever in New York.

* In French, "l'amer et le rouge cinchoniques."

† The cuspare bark (Cort. Angosturæ) yields with iron a yellow precipitate; yet it is employed on the banks of the Orinoco, and particularly at the town of St. Thomas of Angostura, as an excellent cinchona; and on the other hand, the bark of the common cherry tree, which has

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specimens of sugar and tannin extracted from plants, not of the same family, present numerous differences: while the comparative analysis of sugar, gum, and starch; the discovery of the radical of the prussic acid (the effects of which are so powerful on the organization), and many other phenomena of vegetable chemistry, clearly prove that substances composed of identical elements, few in number and proportional in quantity, exhibit the most heterogeneous properties, on account of that particular mode of combination which corpuscular chemistry calls the arrangement of the particles.

Leaving the ravine which descends from the Imposible, we entered a thick forest traversed by many small rivers, which are easily forded. We observed that the cecropia, which in the disposition of its branches and its slender trunk, resembles the palm-tree, is covered with leaves more or less silvery, in proportion as the soil is dry or moist. We saw some small plants of the cecropia, the leaves of which were on both sides entirely green.* The roots of these trees are hid under tufts of dorstenia, which flourishes only in humid and shady places. In the midst of the forest, on the banks of the Rio Cedeno, as well as on the southern declivity of the Cocollar, we find, in their wild state, papaw and orange-trees, bearing large and sweet fruit. These are probably the remains of some conucos, or Indian plantations; for in those countries the orange-tree cannot be counted among the indigenous plants, any more than the banana-tree, the papaw-tree, maize, cassava, and many other useful plants, with the true country of which we are unacquainted, though they have accompanied man in his migrations from the remotest times.

When a traveller newly arrived from Europe penetrates for the first time into the forests of South America, he be-

scarcely any febrifuge quality, yields a green precipitate like the real cinchonas. Notwithstanding the extreme imperfection of vegetable chemistry, the experiments already made on cinchonas sufficiently show, that to judge of the febrifuge virtues of a bark, we must not attach too much importance either to the principle which turns to green the oxides of iron, or to the tannin, or to the matter which precipitates infusions of tan.

* Is not the Cecropia concolor of Willdenouw a variety of the Cecropia peltata?

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holds nature under an unexpected aspect. He feels at every step, that he is not on the confines but in the centre of the torrid zone; not in one of the West India Islands, but on a vast continent where everything is gigantic,—mountains, rivers, and the mass of vegetation. If he feel strongly the beauty of picturesque scenery he can scarcely define the various emotions which crowd upon his mind; he can scarcely distinguish what most excites his admiration, the deep silence of those solitudes, the individual beauty and contrast of forms, or that vigour and freshness of vegetable life which characterize the climate of the tropics. It might be said that the earth, overloaded with plants, does not allow them space enough to unfold themselves. The trunks of the trees are everywhere concealed under a thick carpet of verdure; and if we carefully transplanted the orchideæ, the pipers, and the pothoses, nourished by a single courbaril, or American fig-tree,* we should cover a vast extent of ground. By this singular assemblage, the forests, as well as the flanks of the rocks and mountains, enlarge the domains of organic nature. The same lianas which creep on the ground, reach the tops of the trees, and pass from one to another at the height of more than a hundred feet. Thus, by the continual interlacing of parasite plants, the botanist is often led to confound one with another, the flowers, the fruits, and leaves, which belong to different species.

We walked for some hours under the shade of these arcades, which scarcely admit a glimpse of the sky; the latter appeared to me of an indigo blue, the deeper in shade because the green of the equinoctial plants is generally of a stronger hue, with somewhat of a brownish tint. A great fern tree,† very different from the Polypodium arboreum of the West Indies, rose above masses of scattered rocks. In this place we were struck for the first time with the sight of those nests in the shape of bottles, or small bags, which are suspended from the branches of the lowest trees, and which attest the wonderful industry of the orioles, which mingle their warbling with the hoarse cries of the parrots and the macaws. These last, so well known for their vivid colours, fly only in pairs, while the real parrots wander about in flocks of several hundreds. A man must have lived in those

* Ficus nymphæifolia. † Possibly our Aspidium caducum.

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regions, particularly in the hot valleys of the Andes, to conceive how these birds sometimes drown with their voices the noise of the torrents, which dash down from rock to rock.

We left the forests, at the distance of somewhat more than a league from the village of San Fernando. A narrow path led, after many windings, into an open but extremely humid country. In such a site in the temperate zone, the cyperaceous and gramineous plants would have formed vast meadows; here the soil abounded in aquatic plants, with sagittate leaves, and especially in basil plants, among which we noticed the fine flowers of the costus, the thalia, and the heliconia. These succulent plants are from eight to ten feet high, and in Europe one of their groups would be considered as a little wood.

Near San Fernando the evaporation caused by the action of the sun was so great that, being very lightly clothed, we felt ourselves as wet as in a vapour bath. The road was bordered with a kind of bamboo,* which the Indians call iagua, or guadua, and which is more than forty feet in height. Nothing can exceed the elegance of this arborescent gramen. The form and disposition of its leaves give it a character of lightness which contrasts agreeably with its height. The smooth and glossy trunk of the iagua generally bends towards the banks of rivulets, and it waves with the slightest breath of air. The highest reeds† in the south of Europe, can give no idea of the aspect of the arborescent gramina. The bamboo and fern-tree are, of all the vegetable forms between the tropics, those which make the most powerful impression on the imagination of the traveller. Bamboos are less common in South America than is usually believed. They are almost wanting in the marshes and in the vast inundated plains of the Lower Orinoco, the Apure, and the Atabapo, while they form thick woods, several leagues in length, in the north-west, in New Grenada, and in the kingdom of Quito. It might be said that the western declivity of the Andes is their true country; and, what is remarkable enough, we found them not only in the low regions at the level of the ocean, but also in the lofty valleys of the Cordilleras, at the height of 860 toises.

* Bambusa guadua. † Arundo donax.

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The road skirted with the bamboos above mentioned led us to the small village of San Fernando, situated in a narrow plain, surrounded by very steep calcareous rocks. This was the first Mission* we saw in America. The houses, or rather the huts of the Chayma Indians, though separate from each other, are not surrounded by gardens. The streets, which are wide and very strait, cross each other at right angles. The walls of the huts are made of clay, strengthened by lianas. The uniformity of these huts, the grave and taciturn air of their inhabitants, and the extreme neatness of the dwellings, reminded us of the establishments of the Moravian Brethren. Besides their own gardens, every Indian family helps to cultivate the garden of the community, or, as it is called, the *conuco de la comunidad*, which is situated at some distance from the village. In this conuco the adults of each sex work one hour in the morning and one in the evening. In the missions nearest the coast the garden of the community is generally a sugar or indigo plantation, under the direction of the missionary; and its produce, if the law were strictly observed, could be employed only for the support of the church and the purchase of sacerdotal ornaments. The great square of San Fernando, in the centre of the village, contains the church, the dwelling of the missionary, and a very humble-looking edifice pompously called the king's house (Casa del Rey). This is a caravanserai, destined for lodging travellers; and, as we often experienced, infinitely valuable in a country where the name of an inn is still unknown. The Casas del Rey are to be found in all the Spanish colonies, and may be deemed an imitation of the *tambos* of Peru, which were established in conformity with the laws of Manco Capac.

We had been recommended to the friars who govern the Missions of the Chayma Indians, by their syndic, who resides at Cumana. This recommendation was the more useful to us, as the missionaries, either from zeal for the purity of the

* A certain number of habitations collected round a church, with a missionary monk performing the ministerial duties, is called in the Spanish colonies *Mision*, or *Pueblo de mision*. Indian villages, governed by a priest, are called *Pueblos de doctrina*. A distinction is made between the *Cura doctrinero*, who is the priest of an Indian parish, and the *Cura rector*, priest of a village inhabited by whites and men of mixed race.

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morals of their parishioners, or to conceal the monastic system from the indiscreet curiosity of strangers, often adhere with rigour to an old regulation, by which a white man of the secular state is not permitted to sojourn more than one night in an Indian village. The Missions form (I will not say according to their primitive and canonical institutions, but in reality) a distinct and nearly independent hierarchy, the views of which seldom accord with those of the secular clergy.

The missionary of San Fernando was a Capuchin, a native of Aragon, far advanced in years, but strong and healthy. His extreme corpulency, his hilarity, the interest he took in battles and sieges, ill accorded with the ideas we form in northern countries of the melancholy reveries and the contemplative life of missionaries. Though extremely busy about a cow which was to be killed next day, the old monk received us with kindness, and permitted us to hang up our hammocks in a gallery of his house. Seated, without doing anything, the greater part of the day, in an arm-chair of red wood, he bitterly complained of what he called the indolence and ignorance of his countrymen. Our missionary, however, seemed well satisfied with his situation. He treated the Indians with mildness; he beheld his Mission prosper, and he praised with enthusiasm the waters, the bananas, and the dairy-produce of the district. The sight of our instruments, our books, and our dried plants, drew from him a sarcastic smile; and he acknowledged, with the naïveté peculiar to the inhabitants of those countries, that of all the enjoyments of life, without excepting sleep, none was comparable to the pleasure of eating good beef (carne de vaca): thus does sensuality obtain an ascendancy, where there is no occupation for the mind.

The mission of San Fernando was founded about the end of the 17th century, near the junction of the small rivers of the Manzanares and Lucasperez. A fire, which consumed the church and the huts of the Indians, induced the Capuchins to build the village in its present fine situation. The number of families is increased to one hundred, and the missionary observed to us, that the custom of marrying at thirteen or fourteen years of age contributes greatly to this rapid increase of population. He denied that old age was

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so premature among the Chaymas, as is commonly believed in Europe. The government of these Indian parishes is very complicated; they have their governor, their major-alguazils, and their militia-commanders, all copper-coloured natives. The company of archers have their colours, and perform their exercise with the bow and arrow, in shooting at a mark; this is the national guard (militia) of the country. This military establishment, under a purely monastic system, seemed to us very singular.

On the night of the 5th of September, and the following morning, there was a thick fog; yet we were not more than a hundred toises above the level of the sea. I determined geometrically, at the moment of our departure, the height of the great calcareous mountain which rises at 800 toises distance to the south of San Fernando, and forms a perpendicular cliff on the north side. It is only 215 toises higher than the great square; but naked masses of rock, which here exhibit themselves in the midst of a thick vegetation, give it a very majestic aspect.

The road from San Fernando to Cumana passes amidst small plantations, through an open and humid valley. We forded a number of rivulets. In the shade the thermometer did not rise above 30°: but we were exposed to the direct rays of the sun, because the bamboos, which skirted the road, afforded but small shelter, and we suffered greatly from the heat. We passed through the village of Arenas, inhabited by Indians, of the same race as those at San Fernando. But Arenas is no longer a mission; and the natives, governed by a regular priest,* are better clothed, and more civilized. Their church is also distinguished in the country by some rude paintings which adorn its walls. A narrow border encloses figures of armadilloes, caymans, jaguars, and other animals peculiar to the new world.

In this village lives a labourer, Francisco Lozano, who presented a highly curious physiological phenomenon. This man has suckled a child with his own milk. The mother having fallen sick, the father, to quiet the infant, took it into his bed, and pressed it to his bosom. Lozano, then thirty-two years of age, had never before remarked that he

* The four villages of Arenas, Macarapana, Mariguitar, and Aricagua, founded by Aragonese Capuchins, are called *Doctrinas de Encomienda.*

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had milk: but the irritation of the nipple, sucked by the child, caused the accumulation of that liquid. The milk was thick and very sweet. The father, astonished at the increased size of his breast, suckled his child two or three times a day during five months. He drew on himself the attention of his neighbours, but he never thought, as he probably would have done in Europe, of deriving any advantage from the curiosity he excited. We saw the certificate, which had been drawn up on the spot, to attest this remarkable fact, eye-witnesses of which are still living. They assured us that, during this suckling, the child had no other nourishment than the milk of his father. Lozano, who was not at Arenas during our journey in the missions, came to us at Cumana. He was accompanied by his son, then thirteen or fourteen years of age. M. Bonpland examined with attention the father's breasts, and found them wrinkled like those of a woman who has given suck. He observed that the left breast in particular was much enlarged; which Lozano explained to us from the circumstance, that the two breasts did not furnish milk in the same abundance. Don Vicente Emparan, governor of the province, sent a circumstantial account of this phenomenon to Cadiz.

It is not a very uncommon circumstance, to find, among animals, males whose breasts contain milk; and climate does not appear to exercise any marked influence on the greater or less abundance of this secretion. The ancients cite the milk of the he-goats of Lemnos and Corsica. In our own time, we have seen in Hanover, a he-goat, which for a great number of years was milked every other day, and yielded more milk than a female goat. Among the signs of the alleged weakness of the Americans, travellers have mentioned the milk contained in the breasts of men. It is, however, improbable, that it has ever been observed in a whole tribe, in some part of America unknown to modern travellers; and I can affirm that at present it is not more common in the new continent, than in the old. The labourer of Arenas, whose case has just been mentioned, was not of the copper-coloured race of Chayma Indians, but was a white man, descended from Europeans. Moreover, the anatomists of St. Petersburgh have observed that, among the lower orders of the people in Russia, milk in the breasts of

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men is much more frequent than among the more southern nations: yet the Russians have never been deemed weak and effeminate. There is among the varieties of the human species a race of men whose breasts at the age of puberty acquire a considerable bulk. Lozano did not belong to that race; and he often repeated to us his conviction, that it was only the irritation of the nipple, in consequence of the suction, which caused the flow of milk.

When we reflect on the whole of the vital phenomena, we find that no one of them is entirely isolated. In every age examples are cited of very young girls and women in extreme old age, who have suckled children. Among men these examples are more rare; and after numerous researches, I have not found above two or three. One is cited by the anatomist of Verona, Alexander Benedictus, who lived about the end of the fifteenth century. He relates the history of an inhabitant of Syria, who, to calm the fretfulness of his child, after the death of the mother, pressed it to his bosom. The milk soon became so abundant, that the father could take on himself the nourishment of his child without assistance. Other examples are related by Santorellus, Faria, and Robert, bishop of Cork. The greater part of these phenomena having been noticed in times very remote, it is not uninteresting to physiology, that we can confirm them in our own days.

On approaching the town of Cumanacoa we found a more level soil, and a valley enlarging itself progressively. This small town is situated in a naked plain, almost circular, and surrounded by lofty mountains. It was founded in 1717 by Domingo Arias, on the return of an expedition to the mouth of the Guarapiche, undertaken with the view of destroying an establishment which some French freebooters had attempted to found. The new town was first called San Baltazar de las Arias; but the Indian name Cumanacoa prevailed; in like manner the name of Santiago de Leon, still to be found in our maps, is forgotten in that of Caracas.

On opening the barometer we were struck at seeing the column of mercury scarcely 7·3 lines shorter than on the coasts. The plain, or rather the table-land, on which the town of Cumanacoa is situated, is not more than 104 toises above the level of the sea, which is three or four times less

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than is supposed by the inhabitants of Cumana, on account of their exaggerated ideas of the cold of Cumanacoa. But the difference of climate observable between places so near each other is perhaps less owing to comparative height than to local circumstances. Among these causes we may cite the proximity of the forests; the frequency of descending currents, so common in these valleys, closed on every side; the abundance of rain; and those thick fogs which diminish during a great part of the year the direct action of the solar rays. The decrement of the heat being nearly the same within the tropics, and during the summer under the temperate zone, the small difference of level of one hundred toises should produce only a change in the mean temperature of 1° or 1·5°. But we shall soon find that at Cumanacoa the difference rises to more than four degrees. This coolness of the climate is sometimes the more surprising, as very great heat is felt at Carthago (in the province of Popayan); at Tomependa, on the bank of the river Amazon, and in the valleys of Aragua, to the west of Caracas; though the absolute height of these different places is between 200 and 480 toises. In plains as well as on mountains the isothermal lines (lines of similar heat) are not constantly parallel to the equator, or the surface of the globe. It is the grand problem of meteorology to determine the inflections of these lines, and to discover, amid modifications produced by local causes, the constant laws of the distribution of heat.

The port of Cumana is only seven nautical leagues from Cumanacoa. It scarcely ever rains in the first-mentioned place, while in the latter there are seven months of wintry weather. At Cumanacoa, the dry season begins at the winter solstice, and lasts till the vernal equinox. Light showers are frequent in the months of April, May, and June. The dry weather then returns again, and lasts from the summer solstice to the end of August. Then come the real winter rains, which cease only in the month of November, and during which torrents of water pour down from the skies.

It was during the winter season that we took up our first abode in the Missions. Every night a thick fog covered the sky, and it was only at intervals that I succeeded in taking some observations of the stars. The thermometer kept from

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18·5° to 20°, which under this zone, and to the sensations of a traveller coming from the coasts, appears a great degree of coolness. I never perceived the temperature in the night at Cumana below 21°. The greatest heat is felt from noon to 3 o'clock, the thermometer keeping between 26° and 27°. The maximum of the heat, about two hours after the passage of the sun over the meridian, was very regularly marked by a storm which murmured near. Large black and low clouds dissolved in rain, which came down in torrents: these rains lasted two or three hours, and lowered the thermometer five or six degrees. About five o'clock the rain entirely ceased, the sun reappeared a little before it set, and the hygrometer moved towards the point of dryness; but at eight or nine we were again enveloped in a thick stratum of vapour. These different changes follow successively, we were assured, during whole months, and yet not a breath of wind is felt. Comparative experiments led us to believe that in general the nights at Cumanacoa are from two to three, and the days from four to five centesimal degrees cooler than at the port of Cumana. These differences are great; and if, instead of meteorological instruments, we consulted only our own feelings, we should suppose they were still more considerable.

The vegetation of the plain which surrounds the town is monotonous, but, owing to the extreme humidity of the air, remarkable for its freshness. It is chiefly characterized by an arborescent solanum, forty feet in height, the Urtica baccifera, and a new species of the genus Guettarda.* The ground is very fertile, and might be easily watered if trenches were cut from a great number of rivulets, the springs of which never dry up during the whole year. The most valuable production of the district is tobacco. Since the introduction of the *farm*† in 1779, the cultivation of tobacco in the province of Cumana is nearly confined to the valley of Cumanacoa; as in Mexico it is permitted only in

* These trees are surrounded by Galega pilosa, Stellaria rotundifolia, Aegiphila elata of Swartz, Sauvagesia erecta, Martinia perennis, and a great number of Rivinas. We find among the gramineous plants, in the savanna of Cumanacoa, the Paspalus lenticularis, Panicum ascendens, Pennisetum uniflorum, Gynerium saccharoïdes, Eleusine indica, &c.

† "Estanco real de tabaco," royal monopoly of tobacco.

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the two districts of Orizaba and Cordova. The farm system is a monopoly odious to the people. All the tobacco that is gathered must be sold to government; and to prevent, or rather to diminish fraud, it has been found most easy to concentrate the cultivation in one point. Guards scour the country, to destroy any plantations without the boundaries of the privileged districts; and to inform against those inhabitants who smoke cigars prepared by their own hands.

Next to the tobacco of the island of Cuba and of the Rio Negro, that of Cumana is the most aromatic. It excels all the tobacco of New Spain and of the province of Varinas. We shall give some particulars of its culture, which essentially differs from the method practised in Virginia. The prodigious expansion which is remarked in the solaneous plants of the valley of Cumanacoa, especially in the abundant species of the Solanum arborescens, of aquartia, and of cestrum, seems to indicate the favourable nature of this spot for plantations of tobacco. The seed is sown in the open ground, at the beginning of September; though sometimes not till the month of December, which period is however less favourable for the harvest. The cotyledons appear on the eighth day, and the young plants are covered with large leaves of heliconia and plantain, and shelter them from the direct action of the sun. Great care also is taken to destroy weeds, which, between the tropics, spring up with astonishing rapidity. The tobacco is transplanted into a rich and well-prepared soil, a month or two after it has risen from the seed. The plants are disposed in regular rows, three or four feet distant from each other. Care is taken to weed them often, and the principal stalk is several times topped, till greenish blue spots indicate to the cultivator the maturity of the leaves. They begin to gather them in the fourth month, and this first gathering generally terminates in the space of a few days. It would be better if the leaves were plucked only as they dry. In good years the cultivators cut the plant when it is only four feet high; and the shoot which springs from the root, throws out new leaves with such rapidity that they may be gathered on the thirteenth or fourteenth day. These last have the cellular tissue very much extended, and they contain more water, more albumen, and less of that acrid, volatile principle

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which is but little soluble in water, and in which the stimulant property of tobacco seems to reside.

At Cumanacoa the tobacco, after being gathered, undergoes a preparation which the Spaniards call *cura seca*. The leaves are suspended by threads of cocuiza;* their ribs are taken out, and they are twisted into cords. The prepared tobacco should be carried to the king's warehouses in the month of June; but the indolence of the inhabitants, and the preference they give to the cultivation of maize and cassava, usually prevent them from finishing the preparation before the month of August. It is easy to conceive that the leaves, so long exposed to very moist air, must lose some of their flavour. The administrator of the farm keeps the tobacco deposited in the king's warehouses sixty days without touching it. When this time is expired, the *manoques* are opened to examine the quality. If the administrator find the tobacco well prepared, he pays the cultivator three piastres for the aroba of twenty-five pounds weight. The same quantity is resold for the king's profit at twelve piastres and a half. The tobacco that is rotten (podrido), that is, again gone into a state of fermentation, is publicly burnt; and the cultivator, who has received money in advance from the royal farm, loses irrevocably the fruits of his long labour. We saw heaps, amounting to five hundred arobas, burnt in the great square, which in Europe might have served for making snuff.

The soil of Cumanacoa is so favourable to this branch of culture, that tobacco grows wild, wherever the seed finds any moisture. It grows thus spontaneously at Cerro del Cuchivano, and around the cavern of Caripe. The only kind of tobacco cultivated at Cumanacoa, as well as in the neighbouring districts of Aricagua and San Lorenzo, is that with large sessile leaves,† called Virginia tobacco. The tobacco with petiolate leaves,‡ which is the *yetl* of the ancient Mexicans, is unknown.

In studying the history of our cultivated plants, we are surprised to find that, before the conquest, the use of tobacco was spread through the greater part of America, while the potato was unknown both in Mexico and the West India Islands, where it grows well in the mountainous regions.

* Agave Americana. † Nicotiana Tabacum. ‡ Nicotiana rustica.

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Tobacco has also been cultivated in Portugal since the year 1559, though the potato did not become an object of European agriculture till the end of the seventeenth and beginning of the eighteenth century. This latter plant, which has had so powerful an influence on the well-being of society, has spread in both continents more slowly than tobacco, which can be considered only as an article of luxury.

Next to tobacco, the most important culture of the valley of Cumanacoa is that of indigo. The manufacturers of Cumanacoa, of San Fernando, and of Arenas, produce indigo of greater commercial value than that of Caracas; and often nearly equalling in splendour and richness of colour the indigo of Guatimala. It was from that province that the coasts of Cumana received the first seeds of the Indigofera Anil,* which is cultivated jointly with the Indigofera tinctoria. The rains being very frequent in the valley of Cumanacoa, a plant of four feet high yields no more colouring matter than one of a third part that size in the arid valleys of Aragua, to the west of the town of Caracas.

The manufactories we examined are all built on uniform principles. Two steeping vessels, or vats, which receive the plants intended to be brought into a state of fermentation, are joined together. Each vat is fifteen feet square, and two and a half deep. From these upper vats the liquor runs into beaters, between which is placed the water-mill. The axletree of the great wheel crosses the two beaters. It is furnished with ladles, fixed to long handles, adapted for the beating. From a spacious settling-vat, the colouring fecula is carried to the drying place, and spread on planks of brasiletto, which, having small wheels, can be sheltered under a roof in case of sudden rains. Sloping and very low roofs give the drying place the appearance of hot-houses at some distance. In the valley of Cumanacoa, the fermentation of the plant is produced with astonishing rapidity. It lasts in general but four or five hours. This short duration can be attributed only to the humidity of the climate, and the absence of the sun during the development of the plant.

* The indigo known in commerce is produced by four species of plants; the Indigofera tinctoria, I. anil, I. argentea, and I. disperma. At the Rio Negro, near the frontiers of Brasil, we found the I. argentea growing wild, but only in places anciently inhabited by Indians.

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I think I have observed, in the course of my travels, that the drier the climate, the slower the vat works, and the greater the quantity of indigo, at the minimum of oxidation, contained in the stalks. In the province of Caracas, where 562 cubic feet of the plant slightly piled up yield thirty-five or forty pounds of dry indigo, the liquid does not pass into the beater till after twenty, thirty, or thirty-five hours. It is probable that the inhabitants of Cumanacoa would extract more colouring matter if they left the plants longer steeping in the first vat.* During my abode at Cumana I made solutions of the indigo of Cumanacoa, which is somewhat heavy and coppery, and that of Caracas, in sulphuric acid, in order to compare them, and the solution of the former appeared to me to be of a much more intense blue.

The plain of Cumanacoa, spotted with farms and small plantations of indigo and tobacco, is surrounded with mountains, which towards the south rise to considerable height. Everything indicates that the valley is the bottom of an ancient lake. The mountains, which in ancient times formed its shores, all rise perpendicularly in the direction of the plain. The only outlet for the waters of the lake was on the side of Arenas. In digging foundations, beds of round pebbles, mixed with small bivalve shells, are found; and according to the report of persons worthy of credit, there were discovered, thirty years ago, at the bottom of the ravine of San Juanillo, two enormous femoral bones, four feet long, and weighing more than thirty pounds. The Indians imagined that these were giants' bones; whilst the half-learned sages of the country, who assume the right of explaining everything, gravely asserted that they were mere sports of nature, and little worthy of attention; an opinion founded on the circumstance that human bones decay rapidly in the soil of Cumanacoa. In order to decorate their churches on the festival of the dead, they take skulls from the cemeteries on the coast, where the earth is impregnated with saline substances. These pretended thigh-bones of giants were carried to the port of Cumana, where I sought for them in vain; but from the analogy of some

* The planters are pretty generally of opinion, that the fermentation should never continue less than ten hours.—Beauvais-Raseau, "Art de l'Indigotier," p. 81.

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fossil bones which I brought from other parts of South America, and which have been carefully examined by M. Cuvier, it is probable that the gigantic femoral bones of Cumanacoa belonged to elephants of a species now extinct. It may appear surprising that they were found in a place so little elevated above the present level of the waters; since it is a remarkable fact, that the fragments of the mastodons and fossil elephants which I brought from the equinoctial regions of Mexico, New Grenada, Quito, and Peru, were not found in low regions (as were the megatherium of Rio Luxan* and Virginia,† the great mastodons of the Ohio, and the fossil elephants of the the Susquehanna, in the temperate zone), but on table-lands having from six to fourteen hundred toises of elevation.

As we approached the southern bank of the basin of Cumanacoa, we enjoyed the view of the Turimiquiri.‡ An enormous wall of rocks, the remains of an ancient cliff, rises in the midst of the forests. Farther to the west, at Cerro del Cuchivano, the chain of mountains seems as if broken by the effects of an earthquake. The crevice is more than a hundred and fifty toises wide, is surrounded by perpendicular rocks, and is filled with trees, the interwoven branches of which find no room to spread. This cleft appears like a mine opened by the falling in of the earth. It is intersected by a torrent, the Rio Juagua, and its appearance

* One league south-east from the town of Buenos Ayres.

† The megatherium of Virginia is the megalonyx of Mr. Jefferson. All the enormous remains found in the plains of the new continent, either north or south of the equator, belong, not to the torrid, but to the temperate zone. On the other hand, Pallas observes that in Siberia, consequently also northward of the tropics, fossil bones are never found in mountainous parts. These facts, intimately connected together, seem calculated to lead to the discovery of a great geological law.

‡ Some of the inhabitants pronounce this name Tumuriquiri, others Turumiquiri, or Tumiriquiri. During the whole time of our stay at Cumanacoa, the summit of this mountain was covered with clouds. It appeared uncovered on the evening of the 11th of September, but only for a few minutes. The angle of elevation, taken from the great square of Cumanacoa, was 8° 2′. This determination, and the barometrical measurement which I made on the 13th, may enable us to fix, within a certain approximation, the distance of the mountain at six miles and a third, or 6,050 toises; admitting that the part uncovered by clouds was 850 toises above the plain of Cumanacoa.

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is highly picturesque. It is called Risco del Cuchivano. The river rises at the distance of seven leagues south-west, at the foot of the mountain of the Brigantine, and it forms some beautiful cascades before it spreads through the plain of Cumanacoa.

We visited several times a small farm, the Conuco of Bermudez, opposite the Risco del Cuchivano, where tobacco, plantains, and several species of cotton-trees,* are cultivated in the moist soil; especially that tree, the cotton of which is of a nankeen colour, and which is so common in the island of Margareta.† The proprietor of the farm told us that the Risco or crevice was inhabited by jaguar tigers. These animals pass the day in caverns, and roam around human habitations at night. Being well fed, they grow to the length of six feet. One of them had devoured, in the preceding year, a horse belonging to the farm. He dragged his prey on a fine moonlight night, across the savannah, to the foot of a ceiba‡ of an enormous size. The groans of the dying horse awoke the slaves of the farm, who went out armed with lances and machetes.‖ The tiger, crouching over his prey, awaited their approach with tranquillity, and fell only after a long and obstinate resistance. This fact, and many others verified on the spot, prove that the great jaguar§ of Terra Firma, like the jaguarete of Paraguay, and the real tiger of Asia, does not flee from man when it is dared to close combat, and when not intimidated by the number of its assailants. Naturalists at present admit that Buffon was entirely mistaken with respect to the greatest of the feline race of America. What Buffon says of the cowardice of tigers of the new continent, relates to the small ocelots.¶ At the Orinoco, the real jaguar of America

* Gossypium uniglandulosum, improperly called herbaceum, and G. barbadense.

† G. religiosum. ‡ Bombax Ceiba: five-leaved silk-cotton tree.

‖ Great knives, with very long blades, like a couteau de chasse. No one enters the woods in the torrid zone without being armed with a machete, not only to cut his way through the woods, but as a defence against wild beasts.

§ Felis onca, Lin., which Buffon called *panthère oillée*, and which he believed came from Africa.

¶ Felis pardalis, Lin., or the chibiguazu of Azara, different from the Tlateo-Ocelotl, or tiger-cat of the Aztecs.

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sometimes leaps into the water, to attack the Indians in their canoes.

Opposite the farm of Bermudez, two spacious caverns open into the crevice of Cuchivano, whence at times there issue flames, which may be seen at a great distance in the night; and, judging by the elevation of the rocks, above which these fiery exhalations ascend, we should be led to think that they rise several hundred feet. This phenomenon was accompanied by a subterranean, dull, and long continued noise, at the time of the last great earthquake of Cumana. It is observed chiefly during the rainy season; and the owners of the farms opposite the mountain of Cuchivano allege that the flames have become more frequent since December 1797.

In a herborizing excursion we made at Rinconada we attempted to penetrate into the crevice, wishing to examine the rocks which seemed to contain in their bosom the cause of these extraordinary conflagrations; but the strength of the vegetation, the interweaving of the lianas, and thorny plants, hindered our progress. Happily the inhabitants of the valley themselves felt a warm interest in our researches, less from the fear of a volcanic explosion, than because their minds were impressed with the idea that the Risco del Cuchivano contained a gold mine; and although we expressed our doubts of the existence of gold in a secondary limestone, they insisted on knowing "what the German miner thought of the richness of the vein." Ever since the time of Charles V. and the government of the Welsers, the Alfingers, and the Sailers, at Coro and Caracas, the people of Terra Firma have entertained a great confidence in the Germans with respect to all that relates to the working of mines. Wherever I went in South America, when the place of my birth was known, I was shown samples of ore. In these colonies every Frenchman is supposed to be a physician, and every German a miner.

The farmers, with the aid of their slaves, opened a path across the woods to the first fall of the Rio Juagua; and on the 10th of September we made our excursion to the Cuchivano. On entering the crevice we recognised the proximity of tigers by a porcupine recently embowelled. For greater security the Indians returned to the farm, and brought back

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some dogs of a very small breed. We were assured that in the event of our meeting a jaguar in a narrow path he would spring on the dog rather than on a man. We did not proceed along the brink of the torrent, but on the slope of the rocks which overhung the water. We walked on the side of a precipice from two to three hundred feet deep, on a kind of very narrow cornice, like the road which leads from the Grindelwald along the Mettenberg to the great glacier. When the cornice was so narrow that we could find no place for our feet, we descended into the torrent, crossed it by fording, and then climbed the opposite wall. These descents are very fatiguing, and it is not safe to trust to the lianas, which hang like great cords from the tops of the trees. The creeping and parasite plants cling but feebly to the branches which they embrace; the united weight of their stalks is considerable, and you run the risk of pulling down a whole mass of verdure, if, in walking on a sloping ground, you support your weight by the lianas. The farther we advanced the thicker the vegetation became. In several places the roots of the trees had burst the calcareous rock, by inserting themselves into the clefts that separate the beds. We had some trouble to carry the plants which we gathered at every step. The cannas, the heliconias with fine purple flowers, the costuses, and other plants of the amomum family, here attain eight or ten feet in height, and their fresh tender verdure, their silky gloss, and the extraordinary development of the parenchyma, form a striking contrast with the brown colour of the arborescent ferns, the foliage of which is delicately shaped. The Indians made incisions with their large knives in the trunks of the trees, and fixed our attention on those beautiful red and gold-coloured woods, which will one day be sought for by our turners and cabinet-makers. They showed us a plant of the compositæ order, twenty feet high (the Eupatorium lævigatum of Lamarck), the rose of Belveria,* celebrated for the brilliancy of its purple flowers, and the dragon's-blood of this country, which is a kind of croton not yet described.† The red and

* Brownea racemosa.

† Plants of families entirely different are called in the Spanish colonies of both continents, *sangre de draco;* they are dracænas, pterocarpi, and crotons. Father Caulin, (Descrip. Corografica, p. 25,) in speaking of

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astringent juice of this plant is employed to strengthen the gums. The Indians recognize the species by the smell, and more particularly by chewing the woody fibres. Two natives, to whom the same wood was given to chew, pronounced without hesitation the same name. We could avail ourselves but little of the sagacity of our guides, for how could we procure leaves, flowers, and fruits growing on trunks, the branches of which commence at fifty or sixty feet high? We were struck at finding in this hollow the bark of trees, and even the soil, covered with moss* and lichens. The cryptogamous plants are here as common as in northern countries. Their growth is favoured by the moisture of the air, and the absence of the direct rays of the sun. Nevertheless the temperature is generally at 25° in the day, and 19° at night.

The rocks which bound the crevice of Cuchivano are perpendicular like walls, and are of the same calcareous formation which we observed the whole way from Punta Delgada. It is here a blackish grey, of compact fracture, tending sometimes towards the sandy fracture, and crossed by small veins of white carbonated lime. In these characteristic marks we thought we discovered the alpine limestone of Switzerland and the Tyrol, of which the colour is always deep, though in a less degree than that of the transition limestone.† The first of these formations constitutes the Cuchivano, the nucleus of the Imposible, and in general the whole group of the mountains of New Andalusia. I saw no petrifactions in it; but the inhabitants assert that considerable masses of shells are found at great heights. The same phenomenon occurs in the country about Salzburg.‡ At the Cuchivano the alpine limestone contains beds of marly clay,§ three or

resins found in the forests of Cumana, makes a just distinction between the *Draco de la Sierra de Unare*, which has pinnate leaves (Pterocarpus Draco), and the *Draco de la Sierra de Paria*, with entire and hairy leaves. The latter is the Croton sanguifluum of Cumanacoa, Caripe, and Cariaco.

* Real *musci frondosi*. We also found, besides a small Boletus stipitatus, of a snow-white colour, the Boletus igniarius, and the Lycoperdon stellatum of Europe. I had found this last only in very dry places in Germany and Poland.

† Escher, in the "Alpina," vol. iv., p. 340.

‡ In Switzerland, the solitary beds of shells, at the height of from 1,300 to 2,000 toises, (in the Jungfrauhorn, the Dent de Morcle, and the Dent du Midi,) belong to transition limestone.

§ Mergelschiefer.

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four toises thick; and this geological fact proves on the one hand the identity of the alpenkalkstein with the zechstein of Thuringia, and on the other the affinity of formation existing between the alpine limestone and that of the Jura.* The strata of marl effervesce with acids, though silex and alumina predominate in them: they are strongly impregnated with carbon, and sometimes blacken the hands, like a real vitriolic schistus. The supposed gold mine of Cuchivano, which was the object of our examination, is nothing but an excavation cut into one of those black strata of marl, which contain pyrites in abundance. The excavation is on the right bank of the river Juagua, and must be approached with caution, because the torrent there is more than eight feet deep. The sulphurous pyrites are found, some massive, and others crystallized and disseminated in the rock; their colour, of a very clear golden yellow, does not indicate that they contain copper. They are mixed with fibrous sulphuret of iron,† and nodules of swinestone, or fetid carbonate of lime. The marly stratum crosses the torrent; and, as the water washes

* The Jura and the Alpine limestone are kindred formations, and they are sometimes difficult to be distinguished, where they lie immediately one upon another, as in the Apennines. The alpine limestone and the zechstein, famous among the geologists of Freyberg, are identical formations. This identity, which I noticed in the year 1793 (Uber die Grubenwetter), is a geological fact the more interesting, as it seems to unite the northern European formations to those of the central chain. It is known that the zechstein is situated between the muriatiferous gypsum and the conglomerate (ancient sandstone); or where there is no muriatiferous gypsum, between the slaty sandstone with roestones (bunte sandstein, Wern.), and the conglomerate or ancient sandstone. It contains strata of schistous and coppery marl (*bituminoce mergel* and *kupferschiefer*) which form an important object in the working of mines at Mansfeld in Saxony, near Riegelsdorf in Hesse, and at Hasel and Prausnitz, in Silesia. In the southern part of Bavaria (Oberbaiern), I saw the alpine limestone, containing these same strata of schistous clay and marl, which, though thinner, whiter, and especially more frequent, characterize the limestone of Jura. Respecting the slates of Blattenberg, in the canton of Glaris, which some mineralogists, because of their numerous impressions of fish, have long mistaken for the cupreous slates of Mansfeld, they belong, according to M. von Buch, to a real transition formation. All these geological data tend to prove that strata of marl, more or less mixed with carbon, are to be found in the limestone of Jura, in the alpine limestone, and in the transition schists. The mixture of carbon, sulphuretted iron, and copper, appears to me to augment with the relative antiquity of the formations.

† Haarkies.

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out metallic grains, the people imagine, on account of the brilliancy of the pyrites, that the torrent bears down gold. It is reported, that, after the great earthquake which took place in 1766, the waters of the Juagua were so charged with gold, that "men who came from a great distance, and whose country was unknown," established washing-places on the spot. They disappeared during the night, after having collected a great quantity of gold. It would be needless to show that this is a fable. Pyrites dispersed in quartzose veins, crossing the mica-slate, are often auriferous, no doubt; but no analogous fact leads to the supposition that the sulphuretted iron which is found in the schistose marls of the alpine limestone, contains gold. Some direct experiments, made with acids, during my abode at Caracas, showed that the pyrites of Cuchivano are not auriferous. Our guides were amazed at my incredulity. In vain I repeated that alum and sulphate of iron only could be obtained from this supposed gold mine; they continued picking up secretly every bit of pyrites they saw sparkling in the water. In countries possessing few mines, the inhabitants entertain exaggerated ideas respecting the facility with which riches are drawn from the bowels of the earth. How much time did we not lose during five years' travels, in visiting, on the pressing invitations of our hosts, ravines, of which the pyritous strata have borne for ages the imposing names of 'Minas de oro!' How often have we been grieved to see men of all classes, magistrates, pastors of villages, grave missionaries, grinding, with inexhaustible patience, amphibole, or yellow mica, in the hope of extracting gold from it by means of mercury! This rage for the search of mines strikes us the more in a climate where the ground needs only to be slightly raked to produce abundant harvests.

After visiting the pyritous marls of the Rio Juagua, we continued following the course of the crevice, which stretches along like a narrow canal overshadowed by very lofty trees. We observed strata on the left bank, opposite Cerro del Cuchivano, singularly crooked and twisted. This phenomenon I had often admired at the Ochsenberg,* in passing the

* This mountain of Switzerland is composed of transition limestone. We find these same inflexions in the strata near Bonneville, at Nante

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lake of Lucerne. The calcareous beds of the Cuchivano and the neighbouring mountains keep pretty regularly the direction of N.N.E. and S.S.W. Their inclination is sometimes north and sometimes south; most commonly they seem to take a direction towards the valley of Cumanacoa; and it cannot be doubted that the valley has an influence* on the inclination of the strata.

We had suffered great fatigue, and were quite drenched by frequently crossing the torrent, when we reached the caverns of the Cuchivano. A wall of rock there rises perpendicularly to the height of eight hundred toises. It is seldom that in a zone where the force of vegetation everywhere conceals the soil and the rocks, we behold a great mountain presenting naked strata in a perpendicular section. In the middle of this section, and in a position unfortunately inaccessible to man, two caverns open in the form of crevices. We were assured that they are inhabited by nocturnal birds, the same as those we were soon to become acquainted with in the *Cueva del Guacharo* of Caripe. Near these caverns we saw strata of schistose marl, and found, with great astonishment, rock-crystals encased in beds of alpine limestone. They were hexahedral prisms, terminated with pyramids, fourteen lines long and eight thick. The crystals, perfectly transparent, were solitary, and often three or four toises distant from each other. They were enclosed in the calcareous mass, as the quartz crystals of Burgtonna,† and the boracite of Lunebourg, are contained in gypsum. There was no crevice near, or any vestige of calcareous spar.‡

d'Arpénas in Savoy, and in the valley of Estaubée in the Pyrenees. Another transition rock, the *grauwakke* of the Germans (very near the English *killas*), exhibits the same phenomenon in Scotland.

* The same observation may apply to the lake of Gemunden in Styria, which I visited with M. von Buch, and which is one of the most picturesque situations in Europe.

† In the duchy of Gotha.

‡ This phenomenon reminds us of another equally rare, the quartz crystals found by M. Freiesleben in Saxony, near Burgörner, in the county of Mansfeld, in the middle of a rock of porous limestone (rauchwakke), lying immediately on the alpine limestone. The rock crystals, which are pretty common in the primitive limestone of Carrara, line the insides of cavities in the rocks, without being enveloped by the rock itself.

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We reposed at the foot of the cavern whence those flames were seen to issue, which of late years have become more frequent. Our guides and the farmer, an intelligent man, equally acquainted with the localities of the province, discussed, in the manner of the Creoles, the dangers to which the town of Cumanacoa would be exposed if the Cuchivano became an active volcano, or, as they expressed it, "se veniesse a reventar." It appeared to them evident, that since the great earthquakes of Quito and Cumana in 1797, New Andalusia was every day more and more undermined by subterranean fires. They cited the flames which had been seen to issue from the earth at Cumana; and the shocks felt in places where heretofore the ground had never been shaken. They recollected that at Macarapan, sulphurous emanations had been frequently perceived for some months past. We were struck with these facts, upon which were founded predictions that have since been almost all realized. Enormous convulsions of the earth took place at Caracas in 1812, and proved how tumultuously nature is agitated in the north-east part of Terra-Firma.

But what is the cause of the luminous phenomena which are observed in the Cuchivano? The column of air which rises from the mouth of a burning volcano* is sometimes observed to shine with a splendid light. This light, which is believed to be owing to the hydrogen gas, was observed from Chillo, on the summit of the Cotopaxi, at a time when the mountain seemed in the greatest repose. According to the statements of the ancients, the Mons Albanus, near Rome, known at present under the name of Monte Cavo, appeared at times on fire during the night; but the Mons Albanus is a volcano recently extinguished, which, in the time of Cato, threw out rapilli;† while the Cuchivano is a calcareous mountain, remote from any trap formation.

* We must not confound this very rare phenomenon with the glimmering commonly observed a few toises above the brink of a crater, and which (as I remarked at Mount Vesuvius in 1805) is only the reflection of great masses of inflamed scoria, thrown up without sufficient force to pass the mouth of the volcano.

† "Albano monte biduum continenter lapidibus pluit."—Livy, lib. xxv. cap. 7. (Heyne, Opuscula Acad., tom. iii. p. 261.)

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Can these flames be attributed to the decomposition of water, entering into contact with the pyrites dispersed through the schistose marl? or is it inflamed hydrogen that issues from the cavern of Cuchivano? The marls, as the smell indicates, are pyritous and bituminous at the same time; and the petroleum springs at the Buen Pastor, and in the island of Trinidad, proceed probably from these same beds of alpine limestone. It would be easy to suppose some connexion between the waters filtering through this calcareous stone, and decomposed by pyrites and the earthquakes of Cumana, the springs of sulphuretted hydrogen in New Barcelona, the beds of native sulphur at Carupano, and the emanations of sulphurous acid which are perceived at times in the savannahs. It cannot be doubted also, that the decomposition of water by the pyrites at an elevated temperature, favoured by the affinity of oxidated iron for earthy substances, may have caused that disengagement of hydrogen gas, to the action of which several modern geologists have attributed so much importance. But in general, sulphurous acid is perceived more commonly than hydrogen in the eruption of volcanoes, and the odour of that acid principally prevails while the earth is agitated by violent shocks. When we take a general view of the phenomena of volcanoes and earthquakes, when we recollect the enormous distance at which the commotion is propagated below the basin of the sea, we readily discard explanations founded on small strata of pyrites and bituminous marls. I am of opinion that the shocks so frequently felt in the province of Cumana are as little to be attributed to the rocks above the surface of the earth, as those which agitate the Apennines are assignable to asphaltic veins or springs of burning petroleum. The whole of these phenomena depend on more general, I would almost say on deeper, causes; and it is not in the secondary strata which form the exterior crust of our globe, but in the primitive rocks, at an enormous distance from the soil, that we should seek the focus of volcanic action. The greater progress we make in geology, the more we feel the insufficiency of theories founded on observations merely local.

On the 12th of September we continued our journey to the convent of Caripe, the principal settlement of the

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Chayma missions. We chose, instead of the direct road, that by the mountains of the Cocollar* and the Turimiquiri, the height of which little exceeds that of Jura. The road first runs eastward, crossing over the length of three leagues the table-land of Cumanacoa, in a soil formerly levelled by the waters: it then turns to the south. We passed the little Indian village of Aricagua surrounded by woody hills. Thence we began to ascend, and the ascent lasted more than four hours. We crossed two-and-twenty times the river of Pututucuar, a rapid torrent, full of blocks of calcareous rock. When, on the Cuesta del Cocollar, we reached an elevation two thousand feet above the level of the sea, we were surprised to find scarcely any forests or great trees. We passed over an immense plain covered with gramineous plants. Mimosas with hemispheric tops, and stems only four or five feet high, alone vary the dull uniformity of the savannahs. Their branches are bent towards the ground or spread out like umbrellas. Wherever there are deep declivities, or masses of rocks half covered with mould, the clusia or cupey, with great nymphæa flowers, displays its beautiful verdure. The roots of this tree are eight inches in diameter, and they sometimes shoot out from the trunk at the height of fifteen feet above the soil.

After having climbed the mountain for a considerable time, we reached a small plain at the Hato del Cocollar. This is a solitary farm, situated on a table-land 408 toises high. We rested three days in this retreat, where we were treated with great kindness by the proprietor, Don Mathias Yturburi, a native of Biscay, who had accompanied us from the port of Cumana. We there found milk, excellent meat from the richness of the pasture, and above all, a delightful climate. During the day the centigrade thermometer did not rise above 22° or 23°; a little before sunset it fell to 19°, and at night it scarcely kept up to 14°.† The nightly temperature was consequently seven degrees colder than that of the coasts, which is a fresh proof of an extremely rapid

* Is this name of Indian origin? At Cumana I heard it derived in a manner somewhat far-fetched from the Spanish word *cogollo*, signifying the heart of oleraceous plants. The Cocollar forms the centre of the whole group of the mountains of New Andalusia.

† 11.2° Reaum.

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decrement of heat, the table-land of Cocollar being less elevated than the site of the town of Caracas.

As far as the eye could reach, we perceived, from this elevated point, only naked savannahs. Small tufts of scattered trees rise in the ravines; and notwithstanding the apparent uniformity of vegetation, great numbers of curious plants* are found here. We shall only speak of a superb lobelia† with purple flowers; the Brownea coccinea, which is upwards of a hundred feet high; and above all, the pejoa, celebrated in the country on account of the delightful and aromatic perfume emitted by its leaves when rubbed between the fingers.‡ But the great charms of this solitary place were the beauty and serenity of the nights. The proprietor of the farm, who spent his evenings with us, seemed to enjoy the astonishment produced on Europeans newly transplanted to the tropics, by that vernal freshness of the air which is felt on the mountains after sunset. In those distant regions, where men yet feel the full value of the gifts of nature, a land-holder boasts of the water of his spring, the absence of noxious insects, the salutary breeze that blows round his hill, as we in Europe descant on the conveniences of our dwellings, and the picturesque effect of our plantations.

Our host had visited the new world with an expedition which was to form establishments for felling wood for the Spanish navy on the shores of the gulf of Paria. In the vast forests of mahogany, cedar, and brazil-wood, which border the Caribbean Sea, it was proposed to select the

* Cassia acuta, Andromeda rigida, Casearia hypericifolia, Myrtus longifolia, Buettneria salicifolia, Glycine picta, G. pratensis, G. gibba, Oxalis umbrosa, Malpighia caripensis, Cephælis salicifolia, Stylosanthes angustifolia, Salvia pseudococcinea, Eryngium fœtidum. We found a second time this last plant, but at a considerable height, in the great forests of bark trees surrounding the town of Loxa, in the centre of the Cordilleras.

† Lobelia spectabilis.

‡ It is the Gualtheria odorata. The pejoa is found round the lake of Cocollar, which gives birth to the great river Guarapiche. We met with the same shrub at the Cuchilla de Guanaguana. It is a subalpine plant, which forms at the Silla de Caracas a zone much higher than in the province of Cumana. The leaves of the pejoa have even a more agreeable smell than those of the Myrtus pimenta, but they yield no perfume when rubbed a few hours after their separation from the tree.

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trunks of the largest trees, giving them in a rough way the shape adapted to the building of ships, and sending them every year to the dockyard near Cadiz. White men, unaccustomed to the climate, could not support the fatigue of labour, the heat, and the effect of the noxious air exhaled by the forests. The same winds which are loaded with the perfume of flowers, leaves, and woods, infuse also, as we may say, the germs of dissolution into the vital organs. Destructive fevers carried off not only the ship-carpenters, but the persons who had the management of the establishment; and this bay, which the early Spaniards named Golfe Triste (Melancholy Bay), on account of the gloomy and wild aspect of its coasts, became the grave of European seamen. Our host had the rare good fortune to escape these dangers. After having witnessed the death of a great number of his friends, he withdrew from the coast to the mountains of Cocollar.

Nothing can be compared to the majestic tranquillity which the aspect of the firmament presents in this solitary region. When tracing with the eye, at night-fall, the meadows which bounded the horizon,—the plain covered with verdure and gently undulated, we thought we beheld from afar, as in the deserts of the Orinoco, the surface of the ocean supporting the starry vault of Heaven. The tree under which we were seated, the luminous insects flying in the air, the constellations which shone in the south; every object seemed to tell us how far we were from our native land. If amidst this exotic nature we heard from the depth of the valley the tinkling of a bell, or the lowing of herds, the remembrance of our country was awakened suddenly. The sounds were like distant voices resounding from beyond the ocean, and with magical power transporting us from one hemisphere to the other. Strange mobility of the imagination of man, eternal source of our enjoyments and our pains!

We began in the cool of the morning to climb the Turimiquiri. This is the name given to the summit of the Cocollar, which, with the Brigantine, forms one single mass of mountain, formerly called by the natives the Sierra de los Tageres. We travelled along a part of the road on horses, which roam about these savannahs; but some of them are

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used to the saddle. Though their appearance is very heavy, they pass lightly over the most slippery turf. We first stopped at a spring issuing, not from the calcareous rock, but from a layer of quartzose sandstone. The temperature was 21°, consequently 1·5° less than the spring of Quetepe; and the difference of the level is nearly 220 toises. Wherever the sandstone appears above ground the soil is level, and constitutes as it were small platforms, succeeding each other like steps. To the height of 700 toises, and even beyond, this mountain, like those in its vicinity, is covered only with gramineous plants.* The absence of trees is attributed at Cumana to the great elevation of the ground; but a slight reflection on the distribution of plants in the Cordilleras of the torrid zone will lead us to conceive that the summits of New Andalusia are very far from reaching the superior limit of the trees, which in this latitude is at least 1800 toises of absolute height. The smooth turf of the Cocollar begins to appear at 350 toises above the level of the sea, and the traveller may contrive to walk upon this turf till he reaches a thousand toises in height. Farther on, beyond this band covered with gramineous plants, we found, amidst peaks almost inaccessible to man, a small forest of cedrela, javillo,† and mahogany. These local circumstances induce me to think that the mountainous savannahs of the Cocollar and Turimiquiri owe their existence only to the destructive custom practised by the natives of setting fire to the woods when they want to convert the soil into pasturage. Where, during the lapse of three centuries, grasses and alpine plants have covered the soil with a thick carpet, the seeds of trees can no longer germinate and fix themselves in the earth, though birds and winds convey them continually from the distant forests into the savannahs.

* The most abundant species are the paspalus; the Andropogon fastigiatum, which forms the genus Diectomis of M. Palissot de Beauvais; and the Panicum olyroïdes.

† Huras crepitans, of the family of the euphorbias. The growth of its trunk is so enormous, that M. Bonpland measured vats of javillo wood, 14 feet long and 8 wide. These vats, made from one log of wood, are employed to keep the guarapo, or juice of the sugar-cane, and the molasses. The seeds of javillo are a very active poison, and the milk that issues from the petioles, when broken, frequently produced inflammation in our eyes, if by chance the least quantity penetrated under the eyelids.

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The climate of these mountains is so mild that at the farm of the Cocollar the cotton and coffee tree, and even the sugar cane, are cultivated with success. Whatever the inhabitants of the coasts may allege, hoar-frost has never been found in the latitude of 10°, on heights scarcely exceeding those of the Mont d'Or, or the Puy-de-Dôme. The pastures of Turimiquiri become less rich in proportion to the elevation. Wherever scattered rocks afford shade, lichens and some European mosses are found. The Melastoma guacito,* and a shrub, the large and tough leaves of which rustle like parchment† when shaken by the winds, rise here and there in the savannah. But the principal ornament of the turf of these mountains is a liliaceous plant with golden flowers, the Marica martinicensis. It is generally observed in the province of Cumana and Caracas only at 400 or 500 toises of elevation.‡ The whole rocky mass of the Turimiquiri is composed of an alpine limestone, like that of Cumanacoa, and a pretty thin strata of marl and quartzose sandstone. The limestone contains masses of brown oxidated iron and carbonate of iron. I have observed in several places, and very distinctly, that the sandstone not only reposes on the limestone, but that this last rock frequently includes and alternates with the sandstone.

We distinguished clearly the round summit of the Turimiquiri and the lofty peaks or, as they are called, the Cucuruchos, covered with thick vegetation, and infested by tigers which are hunted for the beauty of their skin. This round summit, which is covered with turf, is 707 toises above the level of the ocean. A ridge of steep rocks stretches out westward, and is broken at the distance of a mile by an enormous crevice that descends toward the gulf of Cariaco. At the point which might be supposed to be the continuation of the ridge, two calcareous paps or peaks arise, the most northern of which is the loftiest. It is this last which is more particularly called the Cucurucho de Turimiquiri,

* Melastoma xanthostachys, called *guacito* at Caracas.

† Palicourea rigida, *chaparro bovo*. In the savannahs, or llanos, the same Castilian name is given to a tree of the family of the proteaceæ.

‡ For example, in the Montaña de Avila, on the road from Caracas to La Guayra, and in the Silla de Caracas. The seeds of the marica are ripe at the end of December.

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and which is considered to be higher than the mountain of the Brigantine, so well known by the sailors who frequent the coasts of Cumana. We measured, by angles of elevation, and a basis, rather short, traced on the round summit, the peak of Cucurucho, which was about 350 toises higher than our station, so that its absolute height exceeded 1050 toises.

The view we enjoyed on the Turimiquiri is of vast extent, and highly picturesque. From the summit to the ocean we perceived chains of mountains extended in parallel lines from east to west, and bounding longitudinal valleys. These valleys are intersected at right angles by an infinite number of small ravines, scooped out by the torrents: the consequence is, that the lateral ranges are transformed into so many rows of paps, some round and others pyramidal. The ground in general is a gentle slope as far as the Imposible; farther on the precipices become bold, and continue so to the shore of the gulf of Cariaco. The form of this mass of mountains reminded us of the chain of the Jura; and the only plain that presents itself is the valley of Cumanacoa. We seemed to look down into the bottom of a funnel, in which we could distinguish, amidst tufts of scattered trees, the Indian village of Aricagua. Towards the north, a narrow slip of land, the peninsula of Araya, formed a dark stripe on the sea, which, being illumined by the rays of the sun, reflected a strong light. Beyond the peninsula the horizon was bounded by Cape Macanao, the black rocks of which rise amid the waters like an immense bastion.

The farm of the Cocollar, situated at the foot of the Turimiquiri, is in latitude 19° 9′ 32″. I found the dip of the needle 42·1°. The needle oscillates 229 times in ten minutes. Possibly masses of brown iron-ore, included in the calcareous rock, caused a slight augmentation in the intensity of the magnetic forces.

On the 14th of September we descended the Cocollar, toward the Mission of San Antonio. After crossing several savannahs strewed with large blocks of calcareous stone, we entered a thick forest. Having passed two ridges of extremely steep mountains,* we discovered a fine valley five or six

* These ridges, which are rather difficult to climb towards the end of the rainy season, are distinguished by the names of Los Yepes and Fantasma.

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leagues in length, pretty uniformly following the direction of east and west. In this valley are situated the Missions of San Antonio and Guanaguana; the first is famous on account of a small church with two towers, built of brick, in pretty good style, and ornamented with columns of the Doric order. It is the wonder of the country. The prefect of the Capuchins completed the building of this church in less than two summers, though he employed only the Indians of his village. The mouldings of the capitals, the cornices, and a frieze decorated with suns and arabesques, are executed in clay mixed with pounded brick. If we are surprised to find churches in the purest Grecian style on the confines of Lapland,* we are still more struck with these first essays of art, in a region where everything indicates the wild state of man, and where the basis of civilization has not been laid by Europeans more than forty years.

I stopped at the Mission of San Antonio only to open the barometer, and to take a few altitudes of the sun. The elevation of the great square above Cumana is 216 toises. After having crossed the village, we forded the rivers Colorado and Guarapiche, both of which rise in the mountains of the Cocollar, and blend their waters lower down towards the east. The Colorado has a very rapid current, and becomes at its mouth broader than the Rhine. The Guarapiche, at its junction with the Rio Areo, is more than twenty-five fathoms deep. Its banks are ornamented by a superb gramen, of which I made a drawing two years afterward on ascending the river Magdalena. The distich-leaved stalk of this gramen often reaches the height of fifteen or twenty feet.†

Towards evening we reached the Mission of Guanaguana, the site of which is almost on a level with the village of San Antonio. The missionary received us cordially; he was an old man, and he seemed to govern his Indians with great

* At Skelefter, near Torneo.—Buch, Voyage en Norwège.

† *Lata,* or *caña brava.* It is a new genus, between aira and arundo. This colossal gramen looks like the donax of Italy. This, the arundinaria of the Mississippi, (ludolfia, Willd., miegia of Persoon,) and the bamboos, are the highest gramens of the New Continent. Its seed has been carried to St. Domingo, where its stalk is employed to thatch the negroes' huts.

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intelligence. The village has existed only thirty years on the spot it now occupies. Before that time it was more to the south, and was backed by a hill. It is astonishing with what facility the Indians are induced to remove their dwellings. There are villages in South America which in less than half a century have thrice changed their situation. The native finds himself attached by ties so feeble to the soil he inhabits, that he receives with indifference the order to take down his house and to rebuild it elsewhere. A village changes its situation like a camp. Wherever clay, reeds, and the leaves of the palm or heliconia are found, a house is built in a few days. These compulsory changes have often no other motive than the caprice of a missionary, who, having recently arrived from Spain, fancies that the situation of the Mission is feverish, or that it is not sufficiently exposed to the winds. Whole villages have been transported several leagues, merely because the monk did not find the prospect from his house sufficiently beautiful or extensive.

Guanaguana has as yet no church. The old monk, who during thirty years had lived in the forests of America, observed to us that the money of the community, or the produce of the labour of the Indians, was employed first in the construction of the missionary's house, next in that of the church, and lastly in the clothing of the Indians. He gravely assured us that this order of things could not be changed on any pretence, and that the Indians, who prefer a state of nudity to the slightest clothing, are in no hurry for their turn in the destination of the funds. The spacious abode of the *padre* had just been finished, and we had remarked with surprise, that the house, the roof of which formed a terrace, was furnished with a great number of chimnies that looked like turrets. This, our host told us, was done to remind him of a country dear to his recollection, and to picture to his mind the winters of Aragon amid the heat of the torrid zone. The Indians of Guanaguana cultivate cotton for their own benefit as well as for that of the church and the missionary. The natives have machines of a very simple construction to separate the cotton from the seeds. These are wooden cylinders of extremely small diameter, within which the cotton passes, and which are made to turn by a treadle. These machines, however imperfect,

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are very useful, and they begin to be imitated in other Missions. The soil of Guanaguana is not less fertile than that of Aricagua, a small neighbouring village, which has also preserved its ancient Indian name. An almuda of land, 1850 square toises, produces in abundant years from 25 to 30 fanegas of maize, each fanega weighing 100 pounds. But here, as in other places, where the bounty of nature retards industry, a very small number of acres are cleared, and the culture of alimentary plants is neglected. Scarcity of subsistence is felt, whenever the harvest is lost by a protracted drought. The Indians of Guanaguana related to us as a fact not uncommon, that in the preceding year they, their wives, and their children, had been for three months *al monte;* by which they meant, wandering in the neighbouring forests, to live on succulent plants, palm-cabbages, fern roots, and fruits of wild trees. They did not speak of this nomade life as of a state of privation.

The beautiful valley of Guanaguana stretches towards the east, opening into the plains of Punzera and Terecen. We wished to visit those plains, and examine the springs of petroleum, lying between the river Guarapiche and the Rio Areo; but the rainy season had already arrived, and we were in daily perplexity how to dry and preserve the plants we had collected. The road from Guanaguana to the village of Punzera runs either by San Felix or by Caycara and Guayuta, which is a farm for cattle (hato) of the missionaries. In this last place, according to the report of the Indians, great masses of sulphur are found, not in a gypseous or calcareous rock, but at a small depth below the soil, in a bed of clay. This singular phenomenon appears to me peculiar to America; we found it also in the kingdom of Quito, and in New Spain. On approaching Punzera, we saw in the savannahs small bags, formed of a silky tissue suspended from the branches of the lowest trees. It is the *seda silvestre*, or wild silk of the country, which has a beautiful lustre, but is very rough to the touch. The phalæna which produces it is probably analagous with that of the provinces of Guanaxuato and Antioquia, which also furnish wild silk. We found in the beautiful forest of Punzera two trees known by the names of curucay and canela; the former, of which

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we shall speak hereafter, yields a resin very much sought after by the *Piaches*, or Indian sorcerers; the leaves of the latter have the smell of the real cinnamon of Ceylon.* From Punzera the road leads by Terecin and Nueva Palencia, (a new colony of Canarians,) to the port of San Juan, situated on the right bank of the river Areo; and it is only by crossing this river in a canoe, that the traveller can arrive at the famous petroleum springs (or mineral tar) of the Buen Pastor. They were described to us as small wells or funnels, hollowed out by nature in a marshy soil. This phenomenon reminded us of the lake of asphaltum, or of *chapapote*, in the island of Trinidad,† which is distant from the Buen Pastor, in a straight line, only thirty-five sea leagues.

Having long struggled to overcome the desire we felt to descend the Guarapiche to the Golfo Triste, we took the direct road to the mountains. The valleys of Guanaguana and Caripe are separated by a kind of dyke, or calcareous ridge, well known by the name of the Cuchilla‡ de Guanaguana. We found this passage difficult, because at that time we had not climbed the Cordilleras; but it is by no means so dangerous as the people at Cumana love to represent it. The path is indeed in several parts only fourteen or fifteen inches broad; and the ridge of the mountain, along which the road runs, is covered with a short slippery turf. The slopes on each side are steep, and the traveller, should he stumble, might slide down to the depth of seven or eight hundred feet. Nevertheless, the flanks of the mountain are steep declivities rather than precipices; and the mules of this country are so sure-footed

* Is this the Laurus cinnamomoides of Mutis? What is that other cinnamon tree which the Indians call *tuorco*, common in the mountains of Tocayo, and at the sources of the Rio Uchere, the bark of which is mixed with chocolate? Father Caulin gives the name of curucay to the Copaifera officinalis, which yields the Balsam of Capivi.—Hist. Corograf., pp. 24 and 34.

† Laguna de la Brea, south-east of the port of Naparima. There is another spring of asphaltum on the eastern coast of the island, in the bay of Mayaro.

‡ Literally "blade of a knife." Throughout all Spanish America the name of "cuchilla" is given to the ridge of a mountain terminated on each side by very steep declivities.

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that they inspire the greatest confidence. Their habits are identical with those of the beasts of burden in Switzerland and the Pyrenees. In proportion as a country is wild, the instinct of domestic animals improves in address and sagacity. When the mules feel themselves in danger, they stop, turning their heads to the right and to the left; and the motion of their ears seems to indicate that they reflect on the decision they ought to take. Their resolution is slow, but always just, if it be spontaneous; that is to say, if it be not thwarted or hastened by the imprudence of the traveller. On the frightful roads of the Andes, during journeys of six or seven months across mountains furrowed by torrents, the intelligence of horses and beasts of burden is manifested in an astonishing manner. Thus the mountaineers are heard to say, "I will not give you the mule whose step is the easiest, but the one which is most intelligent (la mas racional)." This popular expression, dictated by long experience, bears stronger evidence against the theory of animated machines, than all the arguments of speculative philosophy.

When we had reached the highest point of the ridge or cuchilla of Guanaguana, an interesting spectacle unfolded itself before us. We saw comprehended in one view the vast savannahs or meadows of Maturin and of the Rio Tigre;* the peak of the Turimiquiri;† and an infinite number of parallel ridges, which, seen at a distance, looked like the waves of the sea. On the north-east opens the valley in which is situated the convent of Caripe. The aspect of this valley is peculiarly attractive, for being shaded by forests, it forms a strong contrast with the nudity of the neighbouring mountains, which are bare of trees, and covered with gramineous plants. We found the absolute height of the Cuchilla to be 548 toises.

Descending from the ridge by a winding path, we entered into a completely woody country. The soil is covered with moss, and a new species of drosera,§ which by its form reminded us of the drosera of the Alps. The thickness of the forests, and the force of vegetation, augmented

* These natural meadows are part of the llanos or immense steppes bordered by the Orinoco.

† El Cucurucho.

§ Drosera tenella.

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as we approached the convent of Caripe. Everything here changes its aspect, even to the rock that accompanied us from Punta Delgada. The calcareous strata becomes thinner, forming graduated steps, which stretch out like walls, cornices, and turrets, as in the mountains of Jura, those of Pappenheim in Germany, and near Oizow in Galicia. The colour of the stone is no longer of a smoky or bluish grey; it becomes white; its fracture is smooth, and sometimes even imperfectly conchoidal. It is no longer the calcareous formation of the Higher Alps, but a formation to which this serves as a basis, and which is analagous to the Jura limestone. In the chain of the Apennines, between Rome and Nocera, I observed this same immediate superposition.* It indicates, not the transition from one rock to another, but the geological affinity existing between two formations. According to the general type of the secondary strata, recognised in a great part of Europe, the Alpine limestone is separated from the Jura limestone by the muriatiferous gypsum; but often this latter is entirely wanting, or is contained as a subordinate layer in the Alpine limestone. In this case the two great calcareous formations succeed each other immediately, or are confounded in one mass.

The descent from the Cuchilla is far shorter than the ascent. We found the level of the valley of Caripe 200 toises higher than that of the valley of Guanaguana.† A group of mountains of little breadth separates two valleys, one of which is of delicious coolness, while the other is famed for the heat of its climate. These contrasts, so common in Mexico, New Grenada, and Peru, are very rare in the north-east part of South America. Thus Caripe is the only one of the high valleys of New Andalusia which is much inhabited.

* In like manner, near Geneva, the rock of the Mole, belonging to the Alpine limestone, lies under the Jura limestone which forms Mount Salève.

† Absolute height of the convent above the level of the sea, 412 toises.

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Chapter VII.

Convent of Caripe.—Cavern of the Guacharo.—Nocturnal Birds.

An alley of perseas led us to the Hospital of the Aragonese Capuchins. We stopped near a cross of Brazil-wood, erected in the midst of a square, and surrounded with benches, on which the infirm monks seat themselves to tell their rosaries. The convent is backed by an enormous wall of perpendicular rock, covered with thick vegetation. The stone, which is of resplendent whiteness, appears only here and there between the foliage. It is difficult to imagine a more picturesque spot. It recalled forcibly to my remembrance the valleys of Derbyshire, and the cavernous mountains of Muggendorf, in Franconia. Instead of the beeches and maple trees of Europe we here find the statelier forms of the ceiba and the palm-tree, the praga and irassé. Numberless springs gush from the sides of the rocks which encircle the basin of Caripe, and of which the abrupt slopes present, towards the south, profiles of a thousand feet in height. These springs issue, for the most part, from a few narrow crevices. The humidity which they spread around favours the growth of the great trees; and the natives, who love solitary places, form their *conucos* along the sides of these crevices. Plantains and papaw trees are grouped together with groves of arborescent fern; and this mixture of wild and cultivated plants gives the place a peculiar charm. Springs are distinguished from afar, on the naked flanks of the mountains, by tufted masses of vegetation* which at first sight seem suspended from the rocks, and

* Among the interesting plants of the valley of Caripe, we found for the first time a calidium, the trunk of which was twenty feet high (C. arboreum); the Mikania micrantha, which may probably possess some of the alexipharmic properties of the famous *guaco* of the Choco; the Bauhinia obtusifolia, a very large tree, called guarapa by the Indians; the Weinmannia glabra; a tree psychotria, the capsules of which, when rubbed between the fingers, emit a very agreeable orange smell; the Dorstenia Houstoni (raiz de resfriado); the Martynia Craniolaria, the white flowers of which are six or seven inches long; a scrophularia, having the aspect of the Verbascum miconi, and the leaves of which, all radical and hairy, are marked with silvery glands.

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descending into the valley, they follow the sinuosities of the torrents.

We were received with great hospitality by the monks of Caripe. The building has an inner court, surrounded by an arcade, like the convents in Spain. This enclosed place was highly convenient for setting up our instruments and making observations. We found a numerous society in the convent. Young monks, recently arrived from Spain, were just about to settle in the Missions, while old infirm missionaries sought for health in the fresh and salubrious air of the mountains of Caripe. I was lodged in the cell of the superior, which contained a pretty good collection of books. I found there, to my surprise, the *Teatro Critico* of Feijoo, the *Lettres Edifiantes*, and the *Traité d'Electricité* by abbé Nollet. It seemed as if the progress of knowledge advanced even in the forests of America. The youngest of the capuchin monks of the last Mission had brought with him a Spanish translation of Chaptal's Treatise on Chemistry, and he intended to study this work in the solitude where he was destined to pass the remainder of his days. During our long abode in the Missions of South America we never perceived any sign of intolerance. The monks of Caripe were not ignorant that I was born in the protestant part of Germany. Furnished as I was with orders from the court of Spain, I had no motives to conceal from them this fact; nevertheless, no mark of distrust, no indiscreet question, no attempt at controversy, ever diminished the value of the hospitality they exercised with so much liberality and frankness.

The convent is founded on a spot which was anciently called Areocuar. Its height above the level of the sea is nearly the same as that of the town of Caracas, or of the inhabited part of the Blue Mountains of Jamaica. Thus the mean temperatures of these three points, all situated within the tropics, are nearly the same. The necessity of being well clothed at night, and especially at sunrise, is felt at Caripe. We saw the centigrade thermometer at midnight, between 16° and 17·5°; in the morning, between 19° and 20°. About one o'clock it had risen only to 21°, or 22·5°. This temperature is sufficient for the development of the productions of the torrid zone; though, com-

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pared with the excessive heat of the plains of Cumana, we might call it the temperature of spring. Water exposed to currents of air in vessels of porous clay, cools at Caripe, during the night, as low as 13°.

Experience has proved that the temperate climate and rarefied air of this spot are singularly favourable to the cultivation of the coffee-tree, which is well known to flourish on heights. The prefect of the capuchins, an active and enlightened man, has introduced into the province this new branch of agricultural industry. Indigo was formerly planted at Caripe, but the small quantity of fecula yielded by this plant, which requires great heat, caused the culture to be abandoned. We found in the *conuco* of the community many culinary plants, maize, sugar cane, and five thousand coffee-trees, which promised a fine harvest. The friars were in hopes of tripling the number in a few years. We cannot help remarking the uniform efforts for the cultivation of the soil which are manifested in the policy of the monastic hierarchy. Wherever convents have not yet acquired wealth in the New Continent, as formerly in Gaul, in Syria, and in the north of Europe, they exercise a happy influence on the clearing of the ground and the introduction of exotic vegetation. At Caripe, the *conuco* of the community presents the appearance of an extensive and beautiful garden. The natives are obliged to work in it every morning from six to ten, and the alcaldes and alguazils of Indian race overlook their labours. These men are looked upon as great state functionaries, and they alone have the right of carrying a cane. The selection of them depends on the superior of the convent. The pedantic and silent gravity of the Indian alcaldes, their cold and mysterious air, their love of appearing in form at church and in the assemblies of the people, force a smile from Europeans. We were not yet accustomed to these shades of the Indian character, which we found the same at the Orinoco, in Mexico, and in Peru, among people totally different in their manners and their language. The alcaldes came daily to the convent, less to treat with the monks on the affairs of the Mission, than under the pretence of inquiring after the health of the newly-arrived travellers. As we gave them brandy, their visits became more frequent than the monks desired.

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That which confers most celebrity on the valley of Caripe, besides the extraordinary coolness of its climate, is the great *Cueva*, or Cavern of the Guacharo.* In a country where the people love the marvellous, a cavern which gives birth to a river, and is inhabited by thousands of nocturnal birds, the fat of which is employed in the Missions to dress food, is an everlasting object of conversation and discussion. The cavern, which the natives call "a mine of fat," is not in the valley of Caripe itself, but three short leagues distant from the convent, in the direction of west-south-west. It opens into a lateral valley, which terminates at the Sierra del Guacharo.

We set out for the Sierra on the 18th of September, accompanied by the alcaldes, or Indian magistrates, and the greater part of the monks of the convent. A narrow path led us at first towards the south, across a fine plain, covered with beautiful turf. We then turned westward, along the margin of a small river which issues from the mouth of the cavern. We ascended during three quarters of an hour, sometimes in the water, which was shallow, sometimes between the torrent and a wall of rocks, on a soil extremely slippery and miry. The falling down of the earth, the scattered trunks of trees, over which the mules could scarcely pass, and the creeping plants that covered the ground, rendered this part of the road fatiguing. We were surprised to find here, at scarcely 500 toises above the level of the sea, a cruciferous plant, Raphanus pinnatus. Plants of this family are very rare in the tropics; they have in some sort a northern character, and therefore we never expected to see one on the plain of Caripe at so inconsiderable an elevation. The northern character also appears in the Galium caripense, the Valeriana scandens, and a sanicle not unlike the S. marilandica.

At the foot of the lofty mountain of the Guacharo, we were

* The province of Guacharucu, which Delgado visited in 1534, in the expedition of Hieronimo de Ortal, appears to have been situated south or south-east of Macarapana. Has its name any connexion with those of the cavern and the bird? or is this last of Spanish origin? (Laet, Nova Orbis, p. 676). Guacharo means in Castilian "one who cries and laments;" now the bird of the cavern of Caripe, and the guacharaca (Phasianus parraka), are very noisy birds.

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only four hundred paces from the cavern, without yet perceiving the entrance. The torrent runs in a crevice hollowed out by the waters, and we went on under a cornice, the projection of which prevented us from seeing the sky. The path winds in the direction of the river; and at the last turning we came suddenly before the immense opening of the grotto. The aspect of this spot is majestic, even to the eye of a traveller accustomed to the picturesque scenery of the higher Alps. I had before this seen the caverns of the peak of Derbyshire, where, lying down flat in a boat, we proceeded along a subterranean river, under an arch two feet high. I had visited the beautiful grotto of Treshemienshiz, in the Carpathian mountains, the caverns of the Hartz, and those of Franconia, which are vast cemeteries,* containing bones of tigers, hyænas, and bears, as large as our horses. Nature in every zone follows immutable laws in the distribution of rocks, in the form of mountains, and even in those changes which the exterior crust of our planet has undergone. So great a uniformity led me to believe that the aspect of the cavern of Caripe would differ little from what I had observed in my preceding travels. The reality far exceeded my expectations. If the configuration of the grottoes, the splendour of the stalactites, and all the phenomena of inorganic nature, present striking analogies, the majesty of equinoctial vegetation gives at the same time an individual character to the aperture of the cavern.

The Cueva del Guacharo is pierced in the vertical profile of a rock. The entrance is towards the south, and forms an arch eighty feet broad and seventy-two high. The rock which surmounts the grotto is covered with trees of gigantic height. The mammee-tree and the genipa,† with large and

* The mould, which has covered for thousands of years the soil of the caverns of Gaylenreuth and Muggendorf in Franconia, emits even now choke-damps, or gaseous mixtures of hydrogen and nitrogen, which rise to the roof of the caves. This fact is known to the persons who show these caverns to travellers; and when I was director of the mines of the Fichtelberg, I observed it frequently in the summer-time. M. Laugier found in the mould of Muggendorf, besides phosphate of lime, 0·10 of animal matter. I was struck, during my stay at Steeben, with the ammoniacal and fœtid smell produced by it, when thrown on a red-hot iron.

† Caruto, Genipa americana. The flower, at Caripe, has sometimes five, sometimes six stamens.

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shining leaves, raise their branches vertically towards the sky; whilst those of the courbaril and the erythrina form, as they extend, a thick canopy of verdure. Plants of the family of pothos, with succulent stems, oxalises, and orchideæ of a singular structure,* rise in the driest clefts of the rocks; while creeping plants waving in the winds are interwoven in festoons before the opening of the cavern. We distinguished in these festoons a bignonia of a violet blue, the purple dolichos, and for the first time, that magnificent solandra,† which has an orange-coloured flower and a fleshy tube more than four inches long.

But this luxury of vegetation embellishes not only the external arch, it appears even in the vestibule of the grotto. We saw with astonishment plantain-leaved heliconias eighteen feet high, the praga palm-tree, and arborescent arums, following the course of the river, even to those subterranean places. The vegetation continues in the cave of Caripe as in those deep crevices of the Andes, half-excluded from the light of day, and does not disappear till, penetrating into the interior, we advance thirty or forty paces from the entrance. We measured the way by means of a cord; and we went on about four hundred and thirty feet without being obliged to light our torches. Daylight penetrates far into this region, because the grotto forms but one single channel, keeping the same direction, from south-east to north-west. Where the light began to fail, we heard from afar the hoarse sounds of the nocturnal birds; sounds which the natives think belong exclusively to those subterraneous places.

The guacharo is of the size of our fowls. It has the mouth of the goat-suckers and procnias, and the port of those vultures whose crooked beaks are surrounded with stiff silky hairs. Suppressing, with M. Cuvier, the order of picæ, we must refer this extraordinary bird to the passeres, the genera of which are connected with each other by almost imperceptible transitions. It forms a new genus, very different from the goatsucker, in the loudness of its voice, in the vast strength of its beak (containing a double

* A dendrobium, with a gold-coloured flower, spotted with black, three inches long.

† Solandra scandens. It is the *gouaticha* of the Chayma Indians.

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tooth), and in its feet without the membranes which unite the anterior phalanges of the claws. It is the first example of a nocturnal bird among the *Passeres dentirostrati*. Its habits present analogies both with those of the goatsuckers and of the alpine crow.* The plumage of the guacharo is of a dark bluish grey, mixed with small streaks and specks of black. Large white spots of the form of a heart, and bordered with black, mark the head, wings, and tail. The eyes of the bird, which are dazzled by the light of day, are blue, and smaller than those of the goatsucker. The spread of the wings, which are composed of seventeen or eighteen quill feathers, is three feet and a half. The guacharo quits the cavern at nightfall, especially when the moon shines. It is almost the only frugiferous nocturnal bird yet known; the conformation of its feet sufficiently shows that it does not hunt like our owls. It feeds on very hard fruits, like the nutcracker† and the pyrrhocorax. The latter nestles also in clefts of rocks, and is known by the name of the night-crow. The Indians assured us that the guacharo does not pursue either the lamellicornous insects or those phalænæ which serve as food to the goatsuckers. A comparison of the beaks of the guacharo and the goatsucker serves to denote how much their habits must differ. It would be difficult to form an idea of the horrible noise occasioned by thousands of these birds in the dark part of the cavern. Their shrill and piercing cries strike upon the vaults of the rocks, and are repeated by the subterranean echoes. The Indians showed us the nests of the guacharos by fixing a torch to the end of a long pole. These nests were fifty or sixty feet high above our heads, in holes in the shape of funnels, with which the roof of the grotto is pierced like a sieve. The noise increased as we advanced, and the birds were scared by the light of the torches of copal. When this noise ceased a few minutes around us, we heard at a distance the plaintive cries of the birds roosting in other ramifications of the cavern. It seemed as if different groups answered each other alternately.

* Corvus Pyrrhocorax.

† Corvus caryocatactes; C. glandarius. Our Alpine crow builds its nest near the top of Mount Libanus, in subterranean caverns, nearly like the guacharo. It also has the horribly shrill cry of the latter.

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The Indians enter the Cueva del Guacharo once a-year, near midsummer. They go armed with poles, with which they destroy the greater part of the nests. At that season several thousand birds are killed; and the old ones, as if to defend their brood, hover over the heads of the Indians, uttering terrible cries. The young,* which fall to the ground, are opened on the spot. Their peritoneum is found extremely loaded with fat, and a layer of fat reaches from the abdomen to the anus, forming a kind of cushion between the legs of the bird. This quantity of fat in frugivorous animals, not exposed to the light, and exerting very little muscular motion, reminds us of what has been observed in the fattening of geese and oxen. It is well known how greatly darkness and repose favour this process. The nocturnal birds of Europe are lean, because, instead of feeding on fruits, like the guacharo, they live on the scanty produce of their prey. At the period commonly called, at Caripe, the oil harvest,† the Indians build huts with palm-leaves, near the entrance, and even in the porch of the cavern. There, with a fire of brushwood, they melt in pots of clay the fat of the young birds just killed. This fat is known by the name of butter or oil (manteca, or aceite) of the guacharo. It is half liquid, transparent, without smell, and so pure that it may be kept above a year without becoming rancid. At the convent of Caripe no other oil is used in the kitchen of the monks but that of the cavern; and we never observed that it gave the aliments a disagreeable taste or smell.

The race of the guacharos would have been long ago extinct, had not several circumstances contributed to its preservation. The natives, restrained by their superstitious ideas, seldom have courage to penetrate far into the grotto. It appears also, that birds of the same species dwell in neighbouring caverns, which are too narrow to be accessible to man. Perhaps the great cavern is repeopled by colonies which forsake the small grottoes; for the missionaries assured us, that hitherto no sensible diminution of the birds have been observed. Young guacharos have been sent to the port of Cumana, and have lived there several days without taking any nourishment, the seeds offered to them

* Called Los pollos del Guacharo.
† La cosecha de la manteca.

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not suiting their taste. When the crops and gizzards of the young birds are opened in the cavern, they are found to contain all sorts of hard and dry fruits, which furnish, under the singular name of guacharo seed (semilla del guacharo), a very celebrated remedy against intermittent fevers. The old birds carry these seeds to their young. They are carefully collected, and sent to the sick at Cariaco, and other places of the low regions, where fevers are generally prevalent.

As we continued to advance into the cavern, we followed the banks of the small river which issues from it, and is from twenty-eight to thirty feet wide. We walked on the banks, as far as the hills formed of calcareous incrustations permitted us. Where the torrent winds among very high masses of stalactites, we were often obliged to descend into its bed, which is only two feet deep. We learned with surprise, that this subterranean rivulet is the origin of the river Caripe, which, at the distance of a few leagues, where it joins the small river of Santa Maria, is navigable for canoes. It flows into the river Areo under the name of Caño de Terezen. We found on the banks of the subterranean rivulet a great quantity of palm-tree wood, the remains of trunks, on which the Indians climb to reach the nests hanging from the roofs of the cavern. The rings, formed by the vestiges of the old footstalks of the leaves, furnish as it were the steps of a ladder perpendicularly placed.

The Grotto of Caripe preserves the same direction, the same breadth, and its primitive height of sixty or seventy feet, to the distance of 472 metres, or 1458 feet, accurately measured. We had great difficulty in persuading the Indians to pass beyond the anterior portion of the grotto, the only part which they annually visit to collect the fat. The whole authority of 'los padres' was necessary to induce them to advance as far as the spot where the soil rises abruptly at an inclination of sixty degrees, and where the torrent forms a small subterranean cascade.* The natives connect mystic ideas with this cave, inhabited by nocturnal birds; they believe that the souls of their ancestors sojourn in the deep

* We find the phenomenon of a subterranean cascade, but on a much larger scale, in England, at Yordas Cave, near Kingsdale in Yorkshire.

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recesses of the cavern. "Man," say they, "should avoid places which are enlightened neither by the sun (zis), nor by the moon (nuna)." 'To go and join the guacharos,' is with them a phrase signifying to rejoin their fathers, to die. The magicians (piaches) and the poisoners (imorons) perform their nocturnal tricks at the entrance of the cavern, to conjure the chief of the evil spirits (ivorokiamo). Thus in every region of the earth a resemblance may be traced in the early fictions of nations, those especially which relate to two principles governing the world, the abode of souls after death, the happiness of the virtuous and the punishment of the guilty. The most different and most barbarous languages present a certain number of images, which are the same, because they have their source in the nature of our intelligence and our sensations. Darkness is everywhere connected with the idea of death. The Grotto of Caripe is the Tartarus of the Greeks; and the guacharos, which hover over the rivulet, uttering plaintive cries, remind us of the Stygian birds.

At the point where the river forms the subterranean cascade, a hill covered with vegetation, which is opposite to the opening of the grotto, presents a very picturesque aspect. It is seen at the extremity of a straight passage, 240 toises in length. The stalactites descending from the roof, and resembling columns suspended in the air, are relieved on a back-ground of verdure. The opening of the cavern appeared singularly contracted, when we saw it about the middle of the day, illumined by the vivid light reflected at once from the sky, the plants, and the rocks. The distant light of day formed a strange contrast with the darkness which surrounded us in the vast cavern. We discharged our guns at a venture, wherever the cries of the nocturnal birds and the flapping of their wings, led us to suspect that a great number of nests were crowded together. After several fruitless attempts M. Bonpland succeeded in killing a couple of guacharos, which, dazzled by the light of the torches, seemed to pursue us. This circumstance afforded me the means of making a drawing of this bird, which had previously been unknown to naturalists. We climbed, not without difficulty, the small hill whence the subterranean rivulet descends. We saw that the grotto was perceptibly

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contracted, retaining only forty feet in height, and that it continued stretching to north-east, without deviating from its primitive direction, which is parallel to that of the great valley of Caripe.

In this part of the cavern, the rivulet deposits a blackish mould, very like the matter which, in the grotto of Muggendorf, in Franconia, is called "the earth of sacrifice."* We could not discover whether this fine and spongy mould falls through the cracks which communicate with the surface of the ground above, or is washed down by the rain-water penetrating into the cavern. It was a mixture of silex, alumina, and vegetable detritus. We walked in thick mud to a spot where we beheld with astonishment the progress of subterranean vegetation. The seeds which the birds carry into the grotto to feed their young, spring up wherever they fix in the mould which covers the calcareous incrustations. Blanched stalks, with some half-formed leaves, had risen to the height of two feet. It was impossible to ascertain the species of these plants, their form, colour, and aspect having been changed by the absence of light. These traces of organization amidst darkness forcibly excited the curiosity of the natives, who examined them with silent meditation inspired by a place they seemed to dread. They evidently regarded these subterranean plants, pale and deformed, as phantoms banished from the face of the earth. To me the scene recalled one of the happiest periods of my early youth, a long abode in the mines of Freyberg, where I made experiments on the effects of blanching (étiolement), which are very different, according as the air is pure or overcharged with hydrogen or azote.

The missionaries, with all their authority, could not prevail on the Indians to penetrate farther into the cavern. As the roof became lower the cries of the guacharos were more and more shrill. We were obliged to yield to the pusillanimity of our guides, and trace back our steps. The appearance of the cavern was however very uniform. We found that a bishop of St. Thomas of Guiana had gone farther than ourselves. He had measured nearly 2500 feet from the mouth

* *Opfer-erde* of the cavern of Höhle Berg (or Hole Mountain,—a mountain pierced entirely through).

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to the spot where he stopped, but the cavern extended still farther. The remembrance of this fact was preserved in the convent of Caripe, without the exact period being noted. The bishop had provided himself with great torches of white Castile wax. We had torches composed only of the bark of trees and native resin. The thick smoke which issued from these torches, in a narrow subterranean passage, hurts the eyes and obstructs the respiration.

On turning back to go out of the cavern, we followed the course of the torrent. Before our eyes became dazzled with the light of day we saw on the outside of the grotto the water of the river sparkling amid the foliage of the trees which shaded it. It was like a picture placed in the distance, the mouth of the cavern serving as a frame. Having at length reached the entrance, we seated ourselves on the bank of the rivulet, to rest after our fatigues. We were glad to be beyond the hoarse cries of the birds, and to leave a place where darkness does not offer even the charm of silence and tranquillity. We could scarcely persuade ourselves that the name of the Grotto of Caripe had hitherto been unknown in Europe;* for the guacharos alone might have sufficed to render it celebrated. These nocturnal birds have been no where yet discovered, except in the mountains of Caripe and Cumanacoa. The missionaries had prepared a repast at the entry of the cavern. Leaves of the banana and the vijao,† which have a silky lustre, served us as a table-cloth, according to the custom of the country. Nothing was wanting to our enjoyment, not even remembrances, which are so rare in those countries, where generations disappear without leaving a trace of their existence.

Before we quit the subterranean rivulet and the nocturnal birds, let us cast a last glance at the cavern of the Guacharo, and the whole of the physical phenomena it pre-

* It is surprising that Father Gili, author of the Saggio di Storia Americana, does not mention it, though he had in his possession a manuscript written in 1780 at the convent of Caripe. I gave the first information respecting the Cueva del Guacharo in 1800, in my letters to Messrs. Delambre and Delamétherie, published in the Journal de Physique.

† Heliconia bihai, Linn. The Creoles have changed the *b* of the Haytian word bihao into *v*, and the *h* into *j*, agreeably to the Castilian pronunciation.

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sents. When we have step by step pursued a long series of observations modified by the localities of a place, we love to stop and raise our views to general considerations. Do the great cavities, which are exclusively called caverns, owe their origin to the same causes as those which have produced the lodes of veins and of metalliferous strata, or the extraordinary phenomenon of the porosity of rocks? Do grottoes belong to every formation, or to that period only when organized beings began to people the surface of the globe? These geological questions can be solved only so far as they are directed by the actual state of things, that is, of facts susceptible of being verified by observation.

Considering rocks according to the succession of eras, we find that primitive formations exhibit very few caverns. The great cavities which are observed in the oldest granite, and which are called *fours* (ovens) in Switzerland and in the south of France, when they are lined with rock crystals, arise most frequently from the union of several contemporaneous veins of quartz,* of feldspar, or of fine-grained granite. The gneiss presents, though more seldom, the same phenomenon; and near Wunsiedel,† at the Fichtelgebirge, I had an opportunity of examining crystal *fours* of two or three feet diameter, in a part of the rock not traversed by veins. We are ignorant of the extent of the cavities which subterranean fires and volcanic agitations may have produced in the bowels of the earth in those primitive rocks, which, containing considerable quantities of amphibole, mica, garnet, magnetic iron-stone, and red schorl (titanite), appear to be anterior to granite. We find some fragments of these rocks among the matters ejected by volcanoes. The cavities can be considered only as partial and local phenomena; and their existence is scarcely any contradiction to the notions we have acquired from the experiments of Maskelyne and Cavendish on the mean density of the earth.

* Gleichzeitige Trümmer. To these stone veins which appear to be of the same age as the rock, belong the veins of talc and asbestos in serpentine, and those of quartz traversing schist (Thonschiefer). Jameson on Contemporaneous Veins, in the Mem. of the Wernerian Soc.

† In Franconia, south-east of Luchsburg.

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In the primitive mountains open to our researches, real grottoes, those which have some extent, belong only to calcareous formations, such as the carbonate or sulphate of lime. The solubility of these substances appears to have favoured the action of the subterranean waters for ages. The primitive limestone presents spacious caverns as well as transition limestone,* and that which is exclusively called secondary. If these caverns be less frequent in the first, it is because this stone forms in general only layers subordinate to the mica-slate,† and not a particular system of mountains, into which the waters may filter, and circulate to great distances. The erosions occasioned by this element depend not only on its quantity, but also on the length of time during which it remains, the velocity it acquires by its fall, and the degree of solubility of the rock. I have observed in general, that the waters act more easily on the carbonates and the sulphates of lime of secondary mountains than on the transition limestones, which have a considerable mixture of silex and carbon. On examining the internal structure of the stalactites which line the walls of caverns, we find in them all the characters of a chemical precipitate.

As we approach those periods in which organic life developes itself in a greater number of forms, the phenomenon of grottoes becomes more frequent. There exist several under the name of *baumen*,‡ not in the ancient sandstone to which the great coal formation belongs, but in the Alpine limestone, and in the Jura limestone, which is often only the superior part of the Alpine formation. The Jura limestone§ so abounds with

* In the primitive limestone are found the Kuetzel-loch, near Kaufungen in Silesia, and probably several caverns in the islands of the Archipelago. In the transition limestone we remark the caverns of Elbingerode, of Rubeland, and of Scharzfeld, in the Hartz; those of the Salzfluhe in the Grisons; and, according to Mr. Greenough, that of Torbay in Devonshire.

† Sometimes to gneiss, as at the Simplon, between Dovredo and Crevola.

‡ In the dialect of the German Swiss, *Balmen*. The Baumen of the Sentis, of the Mole, and of the Beatenberg, on the borders of the lake of Thun, belong to the Alpine limestone.

§ I may mention only the grottoes of Boudry, Motiers-Travers, and Valorbe, in the Jura; the grotto of Balme near Geneva; the caverns between Muggendorf and Gaylenreuth in Franconia; Sowia Jama, Ogrodzimiec, and Wlodowice, in Poland.

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caverns in both continents, that several geologists of the school of Freyberg have given it the name of cavern-limestone (höhlenkalkstein). It is this rock which so often interrupts the course of rivers, by engulfing them into its bosom. In this also is formed the famous Cueva del Guacharo, and the other grottoes of the valley of Caripe. The muriatiferous gypsum,* whether it be found in layers in the Jura or Alpine limestone, or whether it separate these two formations, or lie between the Alpine limestone and argillaceous sandstone, also presents, on account of its great solubility, enormous cavities, sometimes communicating with each other at several leagues distance. After the limestone and gypseous formations, there would remain to be examined, among the secondary rocks, a third formation, that of the argillaceous sandstone, newer than the brine-spring formations; but this rock, composed of small grains of quartz cemented by clay, seldom contains caverns; and when it does, they are not extensive. Progressively narrowing towards their extremity, their walls are covered with a brown ochre.

We have just seen, that the form of grottoes depends partly on the nature of the rocks in which they are found; but this form, modified by exterior agents, often varies even in the same formation. The configuration of caverns, like the outline of mountains, the sinuosity of valleys, and so many other phenomena, present at first sight only irregularity and confusion. The appearance of order is resumed, when we can extend our observations over a vast space of ground, which has undergone violent, but periodical and uniform revolutions. From what I have seen in the mountains of Europe, and in the Cordilleras of America, caverns may be divided, according to their interior structure, into three classes. Some have the form of large clefts or crevices, like veins not filled with ore; such as the cavern of Rosenmüller, in Franconia, Elden-hole, in the peak of Derbyshire, and the Sumideros of Chamacasapa in Mexico. Other caverns are open to the light at both ends. These are rocks really pierced; natural galleries, which run through a solitary mountain: such are the Höhleberg of Muggendorf, and the famous cavern called Dantoe by the

* Gypsum of Bottendorf, *schlottengyps*.

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Ottomite Indians. and the Bridge of the Mother of God, by the Mexican Spaniards. It is difficult to decide respecting the origin of these channels, which sometimes serve as beds for subterranean rivers. Are these pierced rocks hollowed out by the impulse of a current? or should we rather admit that one of the openings of the cavern is owing to a falling down of the earth subsequent to its original formation; to a change in the external form of the mountain, for instance, to a new valley opened on its flank? A third form of caverns, and the most common of the whole, exhibits a succession of cavities, placed nearly on the same level, running in the same direction, and communicating with each other by passages of greater or less breadth.

To these differences of general form are added other circumstances not less remarkable. It often happens, that grottoes of little space have extremely wide openings; whilst we have to creep under very low vaults, in order to penetrate into the deepest and most spacious caverns. The passages which unite partial grottoes, are generally horizontal. I have seen some, however, which resemble funnels or wells, and which may be attributed to the escape of some elastic fluid through a mass before being hardened. When rivers issue from grottoes, they form only a single, horizontal, continuous channel, the dilatations of which are almost imperceptible; as in the Cueva del Guacharo we have just described, and the cavern of San Felipe, near Tehuilotepec in the western Cordilleras of Mexico. The sudden disappearance* of the river, which took its rise from this last cavern, has impoverished a district in which farmers and miners equally require water for refreshing the soil and for working hydraulic machinery.

Considering the variety of structure exhibited by grottoes in both hemispheres, we cannot but refer their formation to causes totally different. When we speak of the origin of caverns we must choose between two systems of natural philosophy: one of these systems attributes every thing to instantaneous and violent commotions (for example, to the elastic force of vapours, and to the heavings occasioned

* In the night of the 16th April, 1802.

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by volcanoes); while the other rests on the operation of small powers, which produce effects almost insensibly by progressive action. Those who love to indulge in geological hypotheses must not, however, forget the horizontality so often remarked amidst gypseous and calcareous mountains, in the position of grottoes communicating with each other by passages. This almost perfect horizontality, this gentle and uniform slope, appears to be the result of a long abode of the waters, which enlarge by erosion clefts already existing, and carry off the softer parts the more easily, as clay or muriate of soda is found mixed with the gypsum and fetid limestone. These effects are the same, whether the caverns form one long and continued range, or several of these ranges lie one over another, as happens almost exclusively in gypseous mountains.

That which in shelly or Neptunean rocks is caused by the action of the waters, appears sometimes to be in the volcanic rocks the effect of gaseous emanations* acting in the direction where they find the least resistance. When melted matter moves on a very gentle slope, the great axis of the cavity formed by the elastic fluids is nearly horizontal, or parallel to the plane on which the movement of transition takes place. A similar disengagement of vapours, joined to the elastic force of the gases, which penetrate strata softened and raised up, appears sometimes to have given great extent to the caverns found in *trachytes* or trappean porphyries. These porphyritic caverns, in the Cordilleras of Quito and Peru, bear the Indian name of *Machays*.† They are in general of little depth. They are lined with sulphur, and differ by the enormous size of their openings from those observed in volcanic tufas‡ in Italy, at Teneriffe, and in

* At Vesuvius, the Duke de la Torre showed me, in 1805, in currents of recent lava, cavities extending in the direction of the current, six or seven feet long and three feet high. These little volcanic caverns were lined with specular iron, which cannot be called oligiste iron, since M. Gay-Lussac's last experiments on the oxides of iron.

† Machay is a word of the Quichua language, commonly called by the Spaniards 'the Incas' language.' *Callancamachay* means "a cavern as large as a house," a cavern that serves as a *tambo* or caravansarai.

‡ Sometimes fire acts like water in carrying off masses, and thus the cavities may be caused by an igneous, though more frequently by an aqueous erosion or solution.

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the Andes. It is by connecting in the mind the primitive, secondary, and volcanic rocks, and distinguishing between the oxidated crust of the globe, and the interior nucleus, composed perhaps of metallic and inflammable substances, that we may account for the existence of grottoes everywhere. They act in the economy of nature as vast reservoirs of water and of elastic fluids.

The gypseous caverns glitter with crystallized selenites. Vitreous crystallized plates of brown and yellow stand out on a striated ground composed of layers of alabaster and fetid limestone. The calcareous grottoes have a more uniform tint. They are more beautiful, and richer in stalactites, in proportion as they are narrower, and the circulation of air is less free. By being spacious, and accessible to air, the cavern of Caripe is almost destitute of those incrustations, the imitative forms of which are in other countries objects of popular curiosity. I also sought in vain for subterranean plants, those cryptogamia of the family of the Usneaceæ, which we sometimes find fixed on the stalactites, like ivy on walls, when we penetrate for the first time into a lateral grotto.*

The caverns in mountains of gypsum often contain mephitic emanations and deleterious gases. It is not the sulphate of lime that acts on the atmospheric air, but the clay slightly mixed with carbon, and the fetid limestone, so often mingled with the gypsum. We cannot yet decide, whether the swinestone acts as a hydrosulphuret, or by means of a bituminous principle.† Its property of absorbing oxygen gas is known to all the miners of Thuringia. It is the same as the action of the carburetted clay of the

* Lichen tophicola was discovered when the beautiful cavern of Rosenmüller in Franconia was first opened. The cavity containing the lichen was found closed on all sides by enormous masses of stalactite.

† That description of fetid limestone called by the German mineralogists *stinkstein* is always of a blackish brown colour. It is only by decomposition that it becomes white, after having acted on the surrounding air. The stinkstein which is of secondary formation, must not be confounded with a very white primitive granular limestone of the island of Thasos, which emits, when scraped, a smell of sulphuretted hydrogen. This marble is coarser grained than Carrara (Marmor lunense). It was frequently employed by the Grecian sculptors, and I often picked up fragments of it at the Villa Adriani, near Rome.

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gypseous grottoes, and of the great chambers (sinkwerke) dug in mines of fossil salt which are worked by the introduction of fresh water. The caverns of calcareous mountains are not exposed to those decompositions of the atmospheric air, unless they contain bones of quadrupeds, or the mould mixed with animal gluten and phosphate of lime, from which arise inflammable and fetid gases.

Though we made many enquiries among the inhabitants of Caripe, Cumanacoa, and Cariaco, we did not learn that they had ever discovered in the cavern of Guacharo either the remains of carniverous animals, or those bony breccias of herbivorous animals, which are found in the caverns of Germany and Hungary, and in the clefts of the calcareous rocks of Gibraltar. The fossil bones of the megatherium, of the elephant, and of the mastodon, which travellers have brought from South America, have all been found in the light soil of the valleys and table-lands. Excepting the megalonyx,* a kind of sloth of the size of an ox, described by Mr. Jefferson, I know not a single instance of the skeleton of an animal buried in a cavern of the New World. The extreme scarcity of this geological phenomenon will appear the less surprising to us, if we recollect, that in France, England, and Italy, there are also a great number of grottoes in which we have never met with any vestige of fossil bones.

Although, in primitive nature, whatever relates to ideas of extent and mass is of no great importance, yet I may observe, that the cavern of Caripe is one of the most spacious known to exist in limestone formations. It is at least 900 metres or 2800 feet in length.† Owing to the different degrees of solubility in rocks, it is generally not in calcareous mountains, but in gypseous formations, that we find the most extensive succession of grottoes. In Saxony there are some in gypsum several leagues in length;

* The megalonyx was found in the caverns of Green Briar, in Virginia, at the distance of 1500 leagues from the megatherium, which resembles it very much, and is of the size of the rhinoceros.

† The famous Baumannshöhle in the Hartz, according to Messrs. Gilbert and Ilsen, is only 578 feet in length; the cavern of Scharzfeld 350; that of Gaylenreuth 304; that of Antiparos 300. But according to Saussure, the Grotto of Balme is 1300 feet long.

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for instance, that of Wimelburg, which communicates with the cavern of Cresfield.

The determination of the temperature of grottoes presents a field for interesting observation. The cavern of Caripe, situated nearly in the latitude of 10° 10′, consequently in the centre of the torrid zone, is elevated 506 toises above the level of the sea in the gulf of Cariaco. We found that, in every part of it, in the month of September, the temperature of the internal air was between 18·4° and 18·9° of the centesimal thermometer; the external atmosphere being at 16·2°. At the entrance of the cavern, the thermometer in the open air was at 17·6°; but when immersed in the water of the little subterranean river, it marked, even to the end of the cavern, 16·8°. These experiments are very interesting, if we reflect on the tendency to equilibrium of heat, in the waters, the air, and the earth. When I left Europe, men of science were regretting that they had not sufficient data on what is called, 'the temperature of the interior of the globe;' and it is but very recently that efforts have been made, and with some success, to solve the grand problem of subterranean meteorology. The stony strata that form the crust of our planet, are alone accessible to our examination; and we now know that the mean temperature of these strata varies not only with latitudes and heights, but that, according to the position of the several places, it performs also, in the space of a year, regular oscillations round the mean heat of the neigbouring atmosphere. The time is gone by when men were surprised to find, in other zones, the heat of grottoes and wells differing from that observed in the caves of the observatory at Paris. The same instrument which in those caves marks 12°, rises in the subterraneous caverns of the island of Madeira, near Funchal, to 16·2°; in Joseph's Well, at Cairo* to 21·2°; in the grottoes of the island of Cuba to 22° or 23°.† This increase is nearly in proportion to that of the mean temperature of the atmosphere, from latitude 48° to the tropics.

* At Funchal (lat. 32° 37′) the mean temperature of the air is 20·4°, and at Cairo (lat. 30° 2′), according to Nouet, it is 22·4°.

† The mean temperature of the air at the Havannah, according to Mr. Ferrer, is 25·6°.

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We have just seen that, in the Cueva del Guacharo, the water of the river is nearly 2° colder than the ambient air of the cavern. The water, whether in filtering through the rocks, or in running over stony beds, doubtless imbibes the temperature of these beds. The air contained in the grotto, on the contrary, is not in repose; it communicates with the external atmosphere. Though under the torrid zone, the changes of the external temperature are exceedingly trifling, currents are formed, which modify periodically the internal air. It is consequently the temperature of the waters, that of 16·8°, which we might look upon as the temperature of the earth in those mountains, if we were sure that the waters do not descend rapidly from more elevated neighbouring mountains.

It follows from these observations, that when we cannot obtain results perfectly exact, we find at least under each zone certain numbers which indicate the maximum and minimum. At Caripe, in the equinoctial zone, at an elevation of 500 toises, the mean temperature of the globe is not below 16·8°, which was the degree indicated by the water of the subterranean river. We can even prove that this temperature of the globe is not above 19°, since the air of the cavern, in the month of September, was found to be at 18·7°. As the mean temperature of the atmosphere, in the hottest month, does not exceed 19·5°,* it is probable that a thermometer in the grotto would not rise higher than 19° at any season of the year.

* The mean temperature of the month of September at Caripe is 18·5°; and on the coast of Cumana, where we had opportunities of making numerous observations, the mean heat of the warmest months differs only 1·8° from that of the coldest.

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Chapter VIII.

Departure from Caripe.—Mountain and Forest of Santa Maria.—Mission of Catuaro.—Port of Cariaco.

The days we passed at the Capuchin convent in the mountains of Caripe, glided swiftly away, though our manner of living was simple and uniform. From sunrise to nightfall we traversed the forests and neighbouring mountains, to collect plants. When the winter rains prevented us from undertaking distant excursions, we visited the huts of the Indians, the *conuco* of the community, or those assemblies in which the alcaldes every evening arrange the labours of the succeeding day. We returned to the monastery only when the sound of the bell called us to the refectory to share the repasts of the missionaries. Sometimes, very early in the morning, we followed them to the church, to attend the *doctrina*, that is to say, the religious instruction of the Indians. It was rather a difficult task to explain dogmas to the neophytes, especially those who had but a very imperfect knowledge of the Spanish language. On the other hand, the monks are as yet almost totally ignorant of the language of the Chaymas; and the resemblance of sounds confuses the poor Indians and suggests to them the most whimsical ideas. Of this I may cite an example. I saw a missionary labouring earnestly to prove that *infierno*, hell, and *invierno*, winter, were not one and the same thing; but as different as heat and cold. The Chaymas are acquainted with no other winter than the season of rains; and consequently they imagined the 'Hell of the whites' to be a place where the wicked are exposed to frequent showers. The missionary harangued to no purpose: it was impossible to efface the first impression produced by the analogy between the two consonants. He could not separate in the minds of the neophytes the ideas of *rain* and *hell; invierno* and *infierno*.

After passing almost the whole day in the open air, we employed our evenings, at the convent, in making notes,

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drying our plants, and sketching those that appeared to form new genera. Unfortunately the misty atmosphere of a valley, where the surrounding forests fill the air with an enormous quantity of vapour, was unfavourable to astronomical observations. I spent a part of the nights waiting to take advantage of the moment when some star should be visible between the clouds, near its passage over the meridian. I often shivered with cold, though the thermometer only sunk to 16°, which is the temperature of the day in our climates towards the end of September. The instruments remained set up in the court of the convent for several hours, yet I was almost always disappointed in my expectations. Some good observations of Fomalhaut and of Deneb have given 10° 10′ 14″ as the latitude of Caripe; which proves that the position indicated in the maps of Caulin is 18′ wrong, and in that of Arrowsmith 14′.

Observations of corresponding altitudes of the sun having given me the true time, within about 2″, I was enabled to determine the magnetic variation with precision, at noon. It was, on the 20th of September, 1799, 3° 15′ 30″ north-east; consequently 0° 58′ 15″ less than at Cumana. If we attend to the influence of the horary variations, which in these countries do not in general exceed 8′, we shall find, that at considerable distances the variation changes less rapidly than is usually supposed. The dip of the needle was 42·75°, centesimal division, and the number of oscillations, expressing the intensity of the magnetic forces, rose to 229 in ten minutes.

The vexation of seeing the stars disappear in a misty sky was the only disappointment we felt in the valley of Caripe. The aspect of this spot presents a character at once wild and tranquil, gloomy and attractive. In the solitude of these mountains we are perhaps less struck by the new impressions we receive at every step, than with the marks of resemblance we trace in climates the most remote from each other. The hills by which the convent is backed, are crowned with palm-trees and arborescent ferns. In the evenings, when the sky denotes rain, the air resounds with the monotonous howling of the alouate apes, which resembles the distant sound of wind when it shakes the forest. Yet amid these strange sounds, these wild forms of plants, and these prodigies of a new world, nature everywhere speaks to man in a voice

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familiar to him. The turf that overspreads the soil; the old moss and fern that cover the roots of the trees; the torrents that gush down the sloping banks of the calcareous rocks; in fine, the harmonious accordance of tints reflected by the waters, the verdure, and the sky; everything recalls to the traveller, sensations which he has already felt.

The beauties of this mountain scenery so much engaged us, that we were very tardy in observing the embarrassment felt by our kind entertainers the monks. They had but a slender provision of wine and wheaten bread; and although in those high regions both are considered as belonging merely to the luxuries of the table, yet we saw with regret, that our hosts abstained from them on our account. Our portion of bread had already been diminished three-fourths, yet violent rains still obliged us to delay our departure for two days. How long did this delay appear! It made us dread the sound of the bell that summoned us to the refectory.

We departed at length on the 22nd of September, followed by four mules, laden with our instruments and plants. We had to descend the north-east slope of the calcareous Alps of New Andalusia, which we have called the great chain of the Brigantine and the Cocollar. The mean elevation of this chain scarcely exceeds six or seven hundred toises: in respect to height and geological constitution, we may compare it to the chain of the Jura. Notwithstanding the inconsiderable elevation of the mountains of Cumana, the descent is extremely difficult and dangerous in the direction of Cariaco. The Cerro of Santa Maria, which the missionaries ascend in their journey from Cumana to their convent at Caripe, is famous for the difficulties it presents to travellers. On comparing these mountains with the Andes of Peru, the Pyrenees, and the Alps, which we successively visited, it has more than once occurred to us, that the less lofty summits are sometimes the most inaccessible.

On leaving the valley of Caripe, we first crossed a ridge of hills north-east of the convent. The road led us along a continual ascent through a vast savannah, as far as the table-land of Guardia de San Augustin. We there halted to wait for the Indian who carried the barometer. We found ourselves to be at 538 toises of absolute elevation, or a little higher than the bottom of the cavern of Guacharo. The savannahs

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or natural meadows, which yield excellent pasture for the cows of the convent, are totally devoid of trees or shrubs. It is the domain of the monocotyledonous plants; for amidst the gramina only a few Maguey* plants rise here and there; their flowery stalks being more than twenty-six feet high. Having reached the table-land of Guardia, we appeared to be transported to the bed of an old lake, levelled by the long-continued abode of the waters. We seemed to trace the sinuosities of the ancient shore in the tongues of land which jut out from the craggy rock, and even in the distribution of the vegetation. The bottom of the basin is a savannah, while its banks are covered with trees of full growth. This is probably the most elevated valley in the provinces of Venezuela and Cumana. One cannot but regret, that a spot favoured by so temperate a climate, and which without doubt would be fit for the culture of corn, is totally uninhabited.

From the table-land of Guardia we continued to descend, till we reached the Indian village of Santa Cruz. We passed at first along a slope extremely slippery and steep, to which the missionaries had given the name of Baxada del Purgatorio, or Descent of Purgatory. It is a rock of schistose sandstone, decomposed, covered with clay, the talus of which appears frightfully steep, from the effect of a very common optical illusion. When we look down from the top to the bottom of the hill the road seems inclined more than 60°. The mules in going down draw their hind legs near to their fore legs, and lowering their cruppers, let themselves slide at a venture. The rider runs no risk, provided he slacken the bridle, thereby leaving the animal quite free in his movements. From this point we perceived towards the left the great pyramid of Guacharo. The appearance of this calcareous peak is very picturesque, but we soon lost sight of it, on entering the thick forest, known by the name of the Montaña de Santa Maria. We descended without intermission for seven hours. It is difficult to conceive a more tremendous descent; it is absolutely a road of steps, a kind of ravine, in which, during the rainy season, impetuous torrents dash from rock to rock. The steps are from two to three feet high, and the beasts of burden, after measuring with their eyes the space necessary to let their load pass between

* Agave Americana.

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the trunks of the trees, leap from one rock to another. Afraid of missing their mark, we saw them stop a few minutes to scan the ground, and bring together their four feet like wild goats. If the animal does not reach the nearest block of stone, he sinks half his depth into the soft ochreous clay, that fills up the interstices of the rock. When the blocks are wanting, enormous roots serve as supports for the feet of men and beasts. Some of these roots are twenty inches thick, and they often branch out from the trunks of the trees much above the level of the soil. The Creoles have sufficient confidence in the address and instinct of the mules, to remain in their saddles during this long and dangerous descent. Fearing fatigue less than they did, and being accustomed to travel slowly for the purpose of gathering plants and examining the nature of the rocks, we preferred going down on foot; and, indeed, the care which our chronometers demanded, left us no liberty of choice.

The forest that covers the steep flank of the mountain of Santa Maria, is one of the thickest I ever saw. The trees are of stupendous height and size. Under their bushy, deep green foliage, there reigns continually a kind of dim daylight, a peculiar sort of obscurity, of which our forests of pines, oaks, and beech-trees, convey no idea. Notwithstanding its elevated temperature, it is difficult to believe that the air can dissolve the quantity of water exhaled from the surface of the soil, the foliage of the trees, and their trunks: the latter are covered with a drapery of orchideæ, peperomia, and other succulent plants. With the aromatic odour of the flowers, the fruit, and even the wood, is mingled that which we perceive in autumn in misty weather. Here, as in the forests of the Orinoco, fixing our eyes on the top of the trees, we discerned streams of vapour, whenever a solar ray penetrated, and traversed the dense atmosphere. Our guides pointed out to us among those majestic trees, the height of which exceeded 120 or 130 feet, the *curucay* of Terecen. It yields a whitish liquid, and very odoriferous resin, which was formerly employed by the Cumanagoto and Tagiri Indians, to perfume their idols. The young branches have an agreeable taste, though somewhat astringent. Next to the curucay and enormous trunks of hymenæa, (the diameter of which was more than nine or ten feet), the trees which

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most excited our attention were the dragon's blood (Croton sanguifluum), the purple-brown juice of which flows down a whitish bark; the *calahuala* fern, different from that of Peru, but almost equally medicinal;* and the palm-trees, irasse, macanilla, corozo, and praga.† The last yields a very savoury palm-cabbage, which we had sometimes eaten at the convent of Caripe. These palms with pinnated and thorny leaves formed a pleasing contrast to the fern-trees. One of the latter, the Cyathea speciosa,‡ grows to the height of more than thirty-five feet, a prodigious size for plants of this family. We discovered here, and in the valley of Caripe, five new kinds of arborescent ferns.§ In the time of Linnæus, botanists knew no more than four on both continents.

We observed that the fern-trees are in general much more rare than the palm-trees. Nature has confined them to temperate, moist, and shady places. They shun the direct rays of the sun, and while the pumos, the corypha of the steppes and other palms of America, flourish on the barren and burning plains, these ferns with arborescent trunks, which at a distance look like palm-trees, preserve the character and habits of cryptogamous plants. They love solitary places, little light, moist, temperate and stagnant air. If they sometimes descend towards the sea-coast, it is only under cover of a thick shade. The old trunks of the cyathea and the meniscium are covered with a carbonaceous powder, which, probably being deprived of hydrogen, has a metallic lustre like plumbago. No other plant presents this pheno-

* The calahuala of Caripe is the Polypodium crassifolium; that of Peru, the use of which has been so much extended by Messrs. Ruiz and Pavon, comes from the Aspidium coriaceum, Willd. (Tectaria calahuala, Cav.) In commerce the diaphoretic roots of the Polypodium crassifolium, and of the Acrostichum huascaro, are mixed with those of the *calahuala* or Aspidium coriaceum.

† Aiphanes praga.

‡ Possibly a hemitelia of Robert Brown. The trunk alone is from 22 to 24 feet long. This and the Cyathea excelsa of the Mauritius, are the most majestic of all the fern-trees described by botanists. The total number of these gigantic cryptogamous plants amounts at present to 25 species, that of the palm-trees to 80. With the cyathea grow, on the mountain of Santa Maria, Rhexia juniperina, Chiococca racemosa, and Commelina spicata.

§ Meniscium arborescens, Aspidium caducum, A. rostratum, Cyathea villosa, and C. speciosa.

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menon; for the trunks of the dicotyledons, in spite of the heat of the climate, and the intensity of the light, are less burnt within the tropics than in the temperate zone. It may be said that the trunks of the ferns, which, like the monocotyledons, are enlarged by the remains of the petioles, decay from the circumference to the centre; and that, deprived of the cortical organs through which the elaborated juices descend to the roots, they are burnt more easily by the action of the oxygen of the atmosphere. I brought to Europe some powders with metallic lustre, taken from very old trunks of Meniscium and Aspidium.

In proportion as we descended the mountain of Santa Maria, we saw the arborescent ferns diminish, and the number of palm-trees increase. The beautiful large-winged butterflies (nymphales), which fly at a prodigious height, became more common. Everything denoted our approach to the coast, and to a zone in which the mean temperature of the day is from 28 to 30 degrees.

The weather was cloudy, and led us to fear one of those heavy rains, during which from 1 to 1·3 inch of water sometimes falls in a day. The sun at times illumined the tops of the trees; and, though sheltered from its rays, we felt an oppressive heat. Thunder rolled at a distance; the clouds seemed suspended on the top of the lofty mountains of the Guacharo; and the plaintive howling of the araguatoes, which we had so often heard at Caripe, denoted the proximity of the storm. We now for the first time had a near view of these howling apes. They are of the family of the alouates,* the different species of which have long been confounded one with another. The small sapajous of America, which imitate in whistling the tones of the passeres, have the bone of the tongue thin and simple, but the apes of large size, as the alouates and marimondes,† have the tongue placed on a large bony drum. Their superior larynx has six pouches, in which the voice loses itself; and two of which, shaped like pigeons' nests, resemble the inferior larynx of birds. The air driven with force into the bony drum produces that mournful sound which characterises the araguatoes. I sketched on the spot these organs, which are imper-

* Stentor, Geoffroy. † Ateles, Geoffroy.

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fectly known to anatomists, and published the description of them on my return to Europe.

The araguato, which the Tamanac Indians call *aravata*,* and the Maypures *marave*, resembles a young bear.† It is three feet long, reckoning from the top of the head (which is small and very pyramidal) to the beginning of the prehensile tail. Its fur is bushy, and of a reddish brown; the breast and belly are covered with fine hair, and not bare as in the *mono colorado*, or *alouate roux* of Buffon, which we carefully examined in going from Carthagena to Santa Fé de Bogotá. The face of the araguato is of a blackish blue, and is covered with a fine and wrinkled skin: its beard is pretty long; and, notwithstanding the direction of the facial line, the angle of which is only thirty degrees, the araguato has, in the expression of the countenance, as much resemblance to man as the marimonde (S. belzebuth, Bresson) and the capuchin of the Orinoco (S. chiropotes). Among thousands of araguatoes which we observed in the provinces of Cumana, Caracas, and Guiana, we never saw any change in the reddish brown fur of the back and shoulders, whether we examined individuals or whole troops. It appeared to me in general, that variety of colour is less frequent among monkeys than naturalists suppose.

The araguato of Caripe is a new species of the genus Stentor, which I have above described. It differs equally from the *ouarine* (S. guariba) and the *alouate roux* (S. seniculus, old man of the woods). Its eye, voice, and gait, denote melancholy. I have seen young araguatoes brought up in Indian huts. They never play like the little sagoins, and their gravity was described with much simplicity by Lopez de Gomara, in the beginning of the sixteenth century. "The *Aranata de los Cumaneses*," says this author, "has

* In the writings of the early Spanish missionaries, this monkey is described by the names of *aranata* and *araguato*. In both names we easily discover the same root. The *v* has been transformed into *g* and *n*. The name of *arabata*, which Gumilla gives to the howling apes of the Lower Orinoco, and which Geoffroy thinks belongs to the S. straminea of Great Pará, is the same Tamanac word *aravata*. This identity of names need not surprise us. The language of the Chayma Indians of Cumana is one of the numerous branches of the Tamanac language, and the latter is connected with the Caribbee language of the Lower Orinoco.

† Alouate ourse (Simia ursina).

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the face of a man, the beard of a goat, and a grave demeanor (honrado gesto.)" Monkeys are more melancholy in proportion as they have more resemblance to man. Their sprightliness diminishes, as their intellectual faculties appear to increase.

We stopped to observe some howling monkeys, which, to the number of thirty or forty, crossed the road, passing in a file from one tree to another over the horizontal and intersecting branches. While we were observing their movements, we saw a troop of Indians going towards the mountains of Caripe. They were without clothing, as the natives of this country generally are. The women, laden with rather heavy burdens, closed the march. The men were all armed; and even the youngest boys had bows and arrows. They moved on in silence, with their eyes fixed on the ground. We endeavoured to learn from them whether we were yet far from the Mission of Santa Cruz, where we intended passing the night. We were overcome with fatigue, and suffered from thirst. The heat increased as the storm drew near, and we had not met with a single spring on the way. The words *si, patre; no, patre;* which the Indians continually repeated, led us to think they understood a little Spanish. In the eyes of a native every white man is a monk, a *padre;* for in the Missions the colour of the skin characterizes the monk, more than the colour of the garment. In vain we questioned them respecting the length of the way: they answered, as if by chance, *si* and *no,* without our being able to attach any precise sense to their replies. This made us the more impatient, as their smiles and gestures indicated their wish to direct us; and the forest seemed at every step to become thicker and thicker. At length we separated from the Indians; our guides were able to follow us only at a distance, because the beasts of burden fell at every step in the ravines.

After journeying for several hours, continually descending on blocks of scattered rock, we found ourselves unexpectedly at the outlet of the forest of Santa Maria. A savannah, the verdure of which had been renewed by the winter rains, stretched before us farther than the eye could reach. On the left we discovered a narrow valley, extending as far as the mountains of the Guacharo, and covered with a

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thick forest. Looking downward, the eye rested on the tops of the trees, which, at eight hundred feet below the road, formed a carpet of verdure of a dark and uniform tint. The openings in the forest appeared like vast funnels, in which we could distinguish by their elegant forms and pinnated leaves, the Praga and Irasse palms. But what renders this spot eminently picturesque, is the aspect of the Sierra del Guacharo. Its northern slope, in the direction of the gulf of Cariaco, is abrupt. It presents a wall of rock, an almost vertical profile, exceeding 3000 feet in height. The vegetation which covers this wall is so scanty, that the eye can follow the lines of the calcareous strata. The summit of the Sierra is flat, and it is only at its eastern extremity, that the majestic peak of the Guacharo rises like an inclined pyramid. Its form resembles that of the *needles* and *horns* * of the Alps.

The savannah we crossed to the Indian village of Santa Cruz is composed of several smooth plateaux, lying above each other like terraces. This geological phenomenon, which is repeated in every climate, seems to indicate a long abode of the waters in basins that have poured them from one to the other. The calcareous rock is no longer visible, but is covered with a thick layer of mould. The last time we saw it in the forest of Santa Maria it was slightly porous, and looked more like the limestone of Cumanacoa than that of Caripe. We there found brown iron-ore disseminated in patches, and if we were not deceived in our observation, a Cornu-ammonis, which we could not succeed in our attempt to detach. It was seven inches indiameter. This fact is the more important, as in this part of America we have never seen ammonites. The Mission of Santa Cruz is situated in the midst of the plain. We reached it towards the evening, suffering much from thirst, having travelled nearly eight hours without finding water. The thermometer kept at 26°; accordingly we were not more than 190 toises above the level of the sea.

We passed the night in one of those ajupas called King's houses, which, as I have already said, serve as *tambos* or caravanserais to travellers. The rains prevented any observations of the stars; and the next day, the 23rd of Sep-

* The Shreckhörner, the Finsteraarhorn, &c.

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tember, we continued our descent towards the gulf of Cariaco. Beyond Santa Cruz a thick forest again appears; and in it we found, under tufts of melastomas, a beautiful fern, with osmundia leaves, which forms a new genus of the order of polypodiaceous plants.*

Having reached the mission of Catuaro, we were desirous of continuing our journey eastward by Santa Rosalia, Casanay, San Josef, Carupano, Rio Carives, and the Montaña of Paria; but we learnt with great regret, that torrents of rain had rendered the roads impassable, and that we should run the risk of losing the plants we had already gathered. A rich planter of cacao-trees was to accompany us from Santa Rosalia to the port of Carupano; but when the time of departure approached, we were informed that his affairs had called him to Cumana. We resolved in consequence to embark at Cariaco, and to return directly by the gulf, instead of passing between the island of Margareta and the isthmus of Araya. The Mission of Catuaro is situated on a very wild spot. Trees of full growth still surround the church, and the tigers come by night to devour the poultry and swine belonging to the Indians. We lodged at the dwelling of the priest, a monk of the congregation of the Observance, to whom the Capuchins had confided the Mission, because priests of their own community were wanting.

At this Mission we met Don Alexandro Mexia, the corregidor of the district, an amiable and well-educated man. He gave us three Indians, who, armed with their machetes, were to precede us, and cut our way through the forest. In this country, so little frequented, the power of vegetation is such at the period of the great rains, that a man on horseback can with difficulty make his way through narrow paths, covered with lianas and intertwining branches. To our great annoyance, the missionary of Catuaro insisted on conducting us to Cariaco; and we could not decline the proposal. The movement for independence, which had nearly broken out at Caracas in 1798, had been preceded and followed by great agitation among the slaves at Coro, Maracaibo, and Caraico. At the last of these places an unfortunate negro had been condemned to die, and our host, the vicar of Catuaro, was going thither to offer him spiritual comfort. During

* Polybotya.

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our journey we could not escape conversations, in which the missionary pertinaciously insisted on the necessity of the slave-trade, on the innate wickedness of the blacks, and the benefit they derived from their state of slavery among the Christians! The mildness of Spanish legislation, compared with the Black Code of most other nations that have possessions in either of the Indies, cannot be denied. But such is the state of the negroes, that justice, far from efficaciously protecting them during their lives, cannot even punish acts of barbarity which cause their death.

The road we took across the forest of Catuaro resembled the descent of the mountain Santa Maria; here also, the most difficult and dangerous places have fanciful names. We walked as in a narrow furrow, scooped out by torrents, and filled with fine tenacious clay. The mules lowered their cruppers and slid down the steepest slopes. This descent is called Saca Manteca.* There is no danger in the descent, owing to the great address of the mules of this country. The clay, which renders the soil so slippery, is produced by the numerous layers of sandstone and schistose clay crossing the bluish grey alpine limestone. This last disappears as we draw nearer to Cariaco. When we reached the mountain of Meapira, we found it formed in great part of a white limestone, filled with fossil remains, and from the grains of quartz agglutinated in the mass, it appeared to belong to the great formation of the sea-coast breccias. We descended this mountain on the strata of the rock, the section of which forms steps of unequal height. Farther on, going out of the forest, we reached the hill of 'Buenavista,† well deserving the name it bears; since it commands a view of the town of Cariaco, situated in the midst of a vast plain filled with plantations, huts, and scattered groups of cocoa-palms. To the west of Cariaco extends the wide gulf, which a wall of rock separates from the ocean: and towards the east are seen, like bluish clouds, the high mountains of Paria and Areo. This is one of the most extensive and magnificent prospects that can be enjoyed on the coast of New Andalusia. In the town of Cariaco we found a great

* Or the Butter-Slope. *Manteca* in Spanish signifies butter.

† Mountain of the Fine Prospect.

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part of the inhabitants suffering from intermittent fever; a disease which in autumn assumes a formidable character. When we consider the extreme fertility of the surrounding plains, their moisture, and the mass of vegetation with which they are covered, we may easily conceive why, amidst so much decomposition of organic matter, the inhabitants do not enjoy that salubrity of air which characterizes the climate of Cumana.

The chain of calcareous mountains of the Brigantine and the Cocollar sends off a considerable branch to the north, which joins the primitive mountains of the coast. This branch bears the name of Sierra de Meapire; but towards the town of Cariaco it is called Cerro Grande de Curiaco. Its mean height did not appear to be more than 150 or 200 toises. It was composed, where I could examine it, of the calcareous breccias of the sea-coast. Marly and calcareous beds alternate with other beds containing grains of quartz. It is a very striking phenomenon for those who study the physical aspect of a country, to see a transverse ridge connect at right angles two parallel ridges, of which one, the more southern, is composed of secondary rocks, and the other, the more northern, of primitive rocks. The latter presents, nearly as far as the meridian of Carupano, only mica-slate; but to the east of this point, where it communicates by a transverse ridge (the Sierra de Meapire) with the limestone range, it contains lamellar gypsum, compact limestone, and other rocks of secondary formation. It might be supposed that the southern ridge has transferred these rocks to the northern chain.

When standing on the summit of the Cerro del Meapire, we see the mountain currents flow on one side to the gulf of Paria, and on the other to the gulf of Cariaco. East and west of the ridge there are low and marshy grounds, spreading out without interruption; and if it be admitted that both gulfs owe their origin to the sinking of the earth, and to rents caused by earthquakes, we must suppose that the Cerro de Meapire has resisted the convulsive movements of the globe, and hindered the waters of the gulf of Paria from uniting with those of the gulf of Cariaco. But for this rocky dyke, the isthmus itself in all probability would have had no existence; and from the castle of Araya as far as

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Cape Paria, the whole mass of the mountains of the coast would have formed a narrow island, parallel to the island of Santa Margareta, and four times as long. Not only do the inspection of the ground, and considerations deduced from its *relievo*, confirm these opinions; but a mere glance of the configuration of the coasts, and a geological map of the country, would suggest the same ideas. It would appear that the island of Margareta has been heretofore attached to the coast-chain of Araya by the peninsula of Chacopata and the Caribbee islands, Lobo and Coche, in the same manner as this chain is still connected with that of the Cocollar and Caripe by the ridge of Meapire.

At present we perceive that the humid plains which stretch east and west of the ridge, and which are improperly called the valleys San Bonifacio and Cariaco, are enlarging by gaining on the sea. The waters are receding, and these changes of the shore are very remarkable, more particularly on the coast of Cumana. If the level of the soil seem to indicate that the two gulfs of Cariaco and Paria formerly occupied a much more considerable space, we cannot doubt that at present the land is progressively extending. Near Cumana, a battery, called La Boca, was built in 1791 on the very margin of the sea; in 1799 we saw it very far inland. At the mouth of the Rio Neveri, near the Morro of Nueva Barcelona, the retreat of the waters is still more rapid. This local phenomenon is probably assignable to accumulations of sand, the progress of which has not yet been sufficiently examined. Descending the Sierra de Meapire, which forms the isthmus between the plains of San Bonifacio and Cariaco, we find towards the east the great lake of Putacuao, which communicates with the river Areo, and is four or five leagues in diameter. The mountainous lands that surround this basin are known only to the natives. There are found those great boa serpents known to the Chayma Indians by the name of *guainas*, and to which they fabulously attribute a sting under the tail. Descending the Sierra de Meapire to the west, we find at first a hollow ground (tierra hueca) which, during the great earthquakes of 1766, threw out asphaltum enveloped in viscous petroleum. Farther on, a numberless quantity of sulphureous

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thermal springs* are seen issuing from the soil; and at length we reach the borders of the lake of Campoma, the exhalations from which contribute to the insalubrity of the climate of Cariaco. The natives believe that the hollow is formed by the engulfing of the hot springs; and, judging from the sound heard under the hoofs of the horses, we must conclude that the subterranean cavities are continued from west to east nearly as far as Casanay, a length of three or four thousand toises. A little river, the Rio Azul, runs through these plains, which are rent into crevices by earthquakes. These earthquakes have a particular centre of action, and seldom extend as far as Cumana. The waters of the Rio Azul are cold and limpid; they rise on the western declivity of the mountain of Meapire, and it is believed that they are augmented by infiltrations from the lake Putacuao, situated on the other side of the chain. The little river, together with the sulphureous hot springs, fall into the Laguna de Campoma. This is a name given to a great lagoon, which is divided in dry weather into three basins situated north-west of the town of Cariaco, near the extremity of the gulf. Fetid exhalations arise continually from the stagnant water of this lagoon. The smell of sulphuretted hydrogen is mingled with that of putrid fishes and rotting plants.

Miasms are formed in the valley of Cariaco, as in the Campagna of Rome; but the hot climate of the tropics increases their deleterious energy. These miasms are probably ternary or quaternary combinations of azote, phosphorus, hydrogen, carbon, and sulphur.

The situation of the lagoon of Campoma renders the north-west wind, which blows frequently after sunset, very pernicious to the inhabitants of the little town of Cariaco. Its influence can be the less doubted, as intermitting fevers are observed to degenerate into typhoid fevers, in proportion as we approach the lagoon, which is the principal focus of putrid miasms. Whole families of free negroes, who have small plantations on the northern coast of the gulf of Cariaco, languish in their hammocks from the beginning of the rainy season. These intermittent fevers assume a dan-

* *El Llano de Aguas calientes*, E. N. E. of Cariaco, at the distance of two leagues.

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gerous character, when persons, debilitated by long labour and copious perspiration, expose themselves to the fine rains, which frequently fall as evening advances. Nevertheless, the men of colour, and particularly the Creole negroes, resist much better than any other race, the influence of the climate. Lemonade and infusions of Scoparia dulcis are given to the sick; but the cuspare, which is the cinchona of Angostura, is seldom used.

It is generally observed, that in these epidemics of the town of Cariaco the mortality is less considerable than might be supposed. Intermitting fevers, when they attack the same individual during several successive years, enfeeble the constitution; but this state of debility, so common on the unhealthy coasts, does not cause death. What is remarkable enough, is the belief which prevails here as in the Campagna of Rome, that the air has become progressively more vitiated in proportion as a greater number of acres have been cultivated. The miasms exhaled from these plains have, however, nothing in common with those which arise from a forest when the trees are cut down, and the sun heats a thick layer of dead leaves. Near Cariaco the country is but thinly wooded. Can it be supposed that the mould, fresh stirred and moistened by rains, alters and vitiates the atmosphere more than the thick wood of plants which covers an uncultivated soil? To local causes are joined other causes less problematic. The neighbouring shores of the sea are covered with mangroves, avicennias, and other shrubs with astringent bark. All the inhabitants of the tropics are aware of the noxious exhalations of these plants; and they dread them the more, as their roots and stocks are not always under water, but alternately wetted and exposed to the heat of the sun.* The mangroves produce miasms, because they contain vegeto-animal matter combined with tannin.

* The following is a list of the social plants that cover those sandy plains on the sea-side, and characterize the vegetation of Cumana and the gulf of Cariaco. Rhizophora mangle, Avicennia nitida, Gomphrena flava, G. brachiata, Sesuvium portulacastrum (*vidrio*), Talinum cuspidatum (*vicho*), T. cumanense, Portulacca pilosa (*zargasso*), P. lanuginosa, Illecebrum maritimum, Atriplex cristata, Heliotropium viride, H. latifolium, Verbena cuneata, Mollugo verticillata, Euphorbia maritima, Convolvulus cumanensis.

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The town of Cariaco has been repeatedly sacked in former times by the Caribs. Its population has augmented rapidly since the provincial authorities, in spite of prohibitory orders from the court of Madrid, have often favoured the trade with foreign colonies. The population amounted, in 1800, to more than 6000 souls. The inhabitants are active in the cultivation of cotton, which is of a very fine quality. The capsules of the cotton-tree, when separated from the woolly substance, are carefully burnt; as those husks if thrown into the river, and exposed to putrefaction, yield noxious exhalations. The culture of the cacao-tree has of late considerably diminished. This valuable tree bears only after eight or ten years. Its fruit keeps very badly in the warehouses, and becomes mouldy at the expiration of a year, notwithstanding all the precautions employed for drying it.

It is only in the interior of the province, to the east of the Sierra de Meapire, that new plantations of the cacao-tree are seen. They become there the more productive, as the lands, newly cleared and surrounded by forests, are in contact with an atmosphere damp, stagnant, and loaded with mephitic exhalations. We there see fathers of families, attached to the old habits of the colonists, slowly amass a little fortune for themselves and their children. Thirty thousand cacao-trees will secure competence to a family for a generation and a half. If the culture of cotton and coffee have led to the diminution of cacao in the province of Caracas and in the small valley of Cariaco, it must be admitted that this last branch of colonial industry has in general increased in the interior of the provinces of New Barcelona and Cumana. The causes of the progressive movement of the cacao-tree from west to east may be easily conceived. The province of Caracas has been from a remote period cultivated: and, in the torrid zone, in proportion as a country has been cleared, it becomes drier and more exposed to the winds. These physical changes have been adverse to the propagation of cacao-trees, the plantations of which, diminishing in the province of Caracas, have accumulated eastward on a newly-cleared and virgin soil. The cacao of Cumana is infinitely superior to that of Guayaquil. The best is produced in the valley of San Bonifacio; as the best cacao of New Barcelona, Cara-

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cas, and Guatimala, is that of Capiriqual, Uritucu, and Soconusco. Since the island of Trinidad has become an English colony, the whole of the eastern extremity of the province of Cumana, especially the coast of Paria, and the gulf of the same name, have changed their appearance. Foreigners have settled there, and have introduced the cultivation of the coffee-tree, the cotton-tree, and the sugar-cane of Otaheite. The population has greatly increased at Carupano, in the beautiful valley of Rio Caribe, at Guira, and at the new town of Punta di Piedra, built opposite Spanish Harbour, in the island of Trinidad. The soil is so fertile in the Golfo Triste, that maize yields two harvests in the year, and produces three hundred and eighty fold the quantity sown.

Early in the morning we embarked in a sort of narrow canoe, called a *lancha*, in hopes of crossing the gulf of Cariaco during the day. The motion of the waters resembles that of our great lakes, when they are agitated by the winds. From the embarcadero to Cumana the distance is only twelve nautical leagues. On quitting the little town of Cariaco, we proceeded westward along the river of Carenicuar, which, in a straight line like an artificial canal, runs through gardens and plantations of cotton-trees. On the banks of the river of Cariaco we saw the Indian women washing their linen with the fruit of the parapara (Sapindus saponaria, or soap-berry), an operation said to be very injurious to the linen. The bark of the fruit produces a strong lather; and the fruit is so elastic that if thrown on a stone it rebounds three or four times to the height of seven or eight feet. Being of a spherical form, it is employed in making rosaries.

After we embarked we had to contend against contrary winds. The rain fell in torrents, and the thunder rolled very near. Swarms of flamingoes, egrets, and cormorants filled the air, seeking the shore, whilst the alcatras, a large species of pelican, alone continued peaceably to fish in the middle of the gulf. The gulf of Cariaco is almost everywhere forty-five or fifty fathoms deep; but at its eastern extremity, near Curaguaca, along an extent of five leagues, the lead does not indicate more than three or four fathoms. Here is found the Baxo de la Cotua, a sand-bank, which at low-water appears like a small island. The canoes which carry provisions to Cumana

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sometimes ground on this bank; but always without danger, because the sea is never rough or heavy. We crossed that part of the gulf where hot springs gush from the bottom of the sea. It was flood-tide, so that the change of temperature was not very perceptible: besides, our canoe drove too much towards the southern shore. It may be supposed that strata of water must be found of different temperatures, according to the greater or less depth, and according as the mingling of the hot waters with those of the gulf is accelerated by the winds and currents. The existence of these hot springs, which we were assured raise the temperature of the sea through an extent of ten or twelve thousand square toises, is a very remarkable phenomenon.* Proceeding from the promontory of Paria westward, by Irapa, Aguas Calientes, the gulf of Cariaco, the Brigantine, and the valley of Aragua, as far as the snowy mountains of Merida, a continued band of thermal waters is found in an extent of 150 leagues.

Adverse winds and rainy weather forced us to go on shore at Pericantral, a small farm on the south side of the gulf. The whole of this coast, though covered with beautiful vegetation, is almost wholly uncultivated. There are scarcely seven hundred inhabitants: and, excepting in the village of Mariguitar, we saw only plantations of cocoa-trees, which are the olives of the country. This palm occupies on both continents a zone, of which the mean temperature of the year is not below 20°.† It is, like the chamærops of the basin of the Mediterranean, a true palm-tree of the coast. It prefers salt to fresh water; and flourishes less inland, where the air is not loaded with saline particles, than on the shore. When cocoa-trees are planted in Terra-Firma, or in the Missions of the Orinoco, at a distance from the sea, a considerable quantity of salt, sometimes as much as half a bushel, is thrown into the hole which receives the nut. Among the plants cultivated by man, the sugar-cane, the plantain, the mammee-apple, and alligator-pear (Laurus per-

* In the island of Guadaloupe, there is a fountain of boiling water, which rushes out on the beach. Hot-water springs rise from the bottom of the sea in the gulf of Naples, and near the island of Palma, in the archipelago of the Canary Islands.

† The cocoa-tree grows in the northern hemisphere from the equator to latitude 28°. Near the equator we find it from the plains to the height of 700 toises above the level of the sea.

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sea), alone have the property of the cocoa-tree; that of being watered equally well with fresh and salt water. This circumstance is favourable to their migrations; and if the sugar-cane of the sea-shore yield a syrup that is a little brackish, it is believed at the same time to be better fitted for the distillation of spirit than the juice produced from the canes in inland situations.

The cocoa-tree, in the other parts of America, is in general cultivated around farm-houses, and the fruit is eaten; in the gulf of Cariaco, it forms extensive plantations. In a fertile and moist ground, the tree begins to bear fruit abundantly in the fourth year; but in dry soils it bears only at the expiration of ten years. The duration of the tree does not in general exceed eighty or a hundred years; and its mean height at that age is from seventy to eighty feet. This rapid growth is so much the more remarkable, as other palm-trees, for instance, the *moriche*,* and the palm of Sombrero,† the longevity of which is very great, frequently do not attain a greater height than fourteen or eighteen feet in the space of sixty years. In the first thirty or forty years, a cocoa-tree of the gulf of Cariaco bears every lunation a cluster of ten or fourteen nuts, all of which, however, do not ripen. It may be reckoned that, on an average, a tree produces annually a hundred nuts, which yield eight *flascos*‡ of oil. In Provence, an olive-tree thirty years old yields twenty pounds, or seven flascos of oil, so that it produces something less than a cocoa-tree. There are in the gulf of Cariaco plantations (haciendas) of eight or nine thousand cocoa-trees. They resemble, in their picturesque appearance, those fine plantations of date-trees near Elche, in Murcia, where, over the superficies of one square league, there may be found upwards of 70,000 palms. The cocoa-tree bears fruit in abundance till it is thirty or forty years old; after that age the produce diminishes, and a trunk a hundred years old, without being altogether barren, yields very little. In the town of Cumana there is prepared a great quantity of cocoa-nut oil, which is limpid, without smell, and very fit for burning. The trade in this oil is not less active than that on the coast of Africa for palm-oil, which is obtained from the

* Mauritia flexuosa. † Corypha tectorum.
‡ One flasco contains 70 or 80 cubic inches, Paris measure.

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Elais guineensis, and is used as food. I have often seen canoes arrive at Cumana laden with 3000 cocoa-nuts.

We did not quit the farm of Pericantral till after sunset. The south coast of the gulf presents a most fertile aspect, while the northern coast is naked, dry, and rocky. In spite of this aridity, and the scarcity of rain, of which sometimes none falls for the space of fifteen months,* the peninsula of Araya, like the desert of Canound in India, produces patillas, or water-melons, weighing from fifty to seventy pounds. In the torrid zone, the vapours contained by the air form about nine-tenths of the quantity necessary to its saturation: and vegetation is maintained by the property which the leaves possess of attracting the water dissolved in the atmosphere.

At sunrise, we saw the Zamuro vultures,† in flocks of forty or fifty, perched on the cocoa-trees. These birds range themselves in files to roost together like fowls. They go to roost long before sunset, and do not awake till after the sun is above the horizon. This sluggishness seems as if it were shared in those climates by the trees with pinnate leaves. The mimosas and the tamarinds close their leaves, in a clear and serene sky, twenty-five or thirty-five minutes before sunset, and unfold them in the morning when the solar disk has been visible for an equal space of time. As I noticed pretty regularly the rising and setting of the sun, for the purpose of observing the effect of the mirage, or of the terrestrial refractions, I was enabled to give continued attention to the phenomena of the sleep of plants. I found them the same in the steppes, where no irregularity of the ground interrupted the view of the horizon. It appears, that, accustomed during the day to an extreme brilliancy of light, the sensitive and other leguminous plants with thin and delicate leaves are

* The rains appear to have been more frequent at the beginning of the 16th century. At any rate, the canon of Granada (Peter Martyr d'Anghiera), speaking in the year 1574, of the salt-works of Araya, or of Haraia, described in the fifth chapter of this work, mentions showers (cadentes imbres) as a very common phenomenon. The same author, who died in 1526, affirms that the Indians wrought the salt-works before the arrival of the Spaniards. They dried the salt in the form of bricks; and our writer even then discussed the geological question, whether the clayey soil of Haraia contained salt-springs, or whether it had been impregnated with salt by the periodical inundations of the ocean for ages.

† Vultur aura.

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affected in the evening by the smallest decline in the intensity of the sun's rays; so that for vegetation, night begins there, as with us, before the total disappearance of the solar disk. But why, in a zone where there is scarcely any twilight, do not the first rays of the sun stimulate the leaves with the more strength, as the absence of light must have rendered them more susceptible? Does the humidity deposited on the parenchyma by the cooling of the leaves, which is the effect of the nocturnal radiation, prevent the action of the first rays of the sun? In our climates, the leguminous plants with irritable leaves awake during the twilight of the morning, before the sun appears.

Chapter IX.

Physical Constitution and Manners of the Chaymas.—Their Language.—Filiation of the Nations which inhabit New Andalusia.—Pariagotos seen by Columbus.

I did not wish to mingle with the narrative of our journey to the Missions of Caripe any general considerations on the different tribes of the indigenous inhabitants of New Andalusia; their manners, their languages, and their common origin. Having returned to the spot whence we set out, I shall now bring into one point of view these considerations which are so nearly connected with the history of the human race. As we advance into the interior of the country, these subjects will become even more interesting than the phenomena of the physical world. The north-east part of equinoctial America, Terra-Firma, and the banks of the Orinoco, resemble in respect to the numerous races of people who inhabit them, the defiles of the Caucasus, the mountains of Hindookho, at the northern extremity of Asia, beyond the Tungouses, and the Tartars settled at the mouth of the Lena. The barbarism which prevails throughout these different regions is perhaps less owing to a primitive absence of all kind of civilization, than to the effects of long degradation; for most of the hordes which we designate under the name of savages, are probably the descendants of nations highly advanced in cultivation. How can we distinguish the prolonged infancy of the human race (if, indeed, it anywhere exists), from that state of moral degradation in which solitude, want, com-

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pulsory misery, forced migration, or rigour of climate, obliterate even the traces of civilization? If everything connected with the primitive state of man, and the first population of a continent, could from its nature belong to the domain of history, we might appeal to the traditions of India. According to the opinion frequently expressed in the laws of Menou and in the Ramajan, savages were regarded as tribes banished from civilized society, and driven into the forests. The word *barbarian*, which we have borrowed from the Greeks and Romans, was possibly merely the proper name of one of those rude hordes.

In the New World, at the begining of the conquest, the natives were collected into large societies only on the ridge of the Cordilleras and the coasts opposite to Asia. The plains, covered with forests, and intersected by rivers; the immense savannahs, extending eastward, and bounding the horizon; were inhabited by wandering hordes, separated by differences of language and manners, and scattered like the remnants of a vast wreck. In the absence of all other monuments, we may endeavour, from the analogy of languages, and the study of the physical constitution of man, to group the different tribes, to follow the traces of their distant emigrations, and to discover some of those family features by which the ancient unity of our species is manifested.

In the mountainous regions which we have just traversed,—in the two provinces of Cumana and New Barcelona, the natives, or primitive inhabitants, still constitute about one-half of the scanty population. Their number may be reckoned at sixty thousand; of which twenty-four thousand inhabit New Andalusia. This number is very considerable, when compared with that of the hunting nations of North America; but it appears small, when we consider those parts of New Spain in which agriculture has existed more than eight centuries: for instance, the Intendencia of Oaxaca, which includes the Mixteca and the Tzapoteca of the old Mexican empire. This Intendencia is one-third smaller than the two provinces of Cumana and Barcelona; yet it contains more than four hundred thousand natives of pure copper-coloured race. The Indians of Cumana do not all live within the Missions. Some are dispersed in the neighbourhood of the towns, along the coasts,

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to which they are attracted by the fisheries, and some dwell in little farms on the plains or savannahs. The Missions of the Aragonese Capuchins which we visited, alone contain fifteen thousand Indians, almost all of the Chayma race. The villages, however, are less populous there than in the province of Barcelona. Their average population is only between five or six hundred Indians; while more to the west, in the Missions of the Franciscans of Piritu, we find Indian villages containing two or three thousand inhabitants. In computing at sixty thousand the number of natives in the provinces of Cumana and Barcelona, I include only those who inhabit the mainland, and not the Guayquerias of the island of Margareta, and the great mass of the Guaraunos, who have preserved their independence in the islands formed by the Delta of the Orinoco. The number of these is generally reckoned at six or eight thousand; but this estimate appears to me to be exaggerated. Except a few families of Guaraunos who roam occasionally in the marshy grounds, called *Los Morichales*, and between the Caño de Manamo and the Rio Guarapiche, consequently, on the continent itself, there have not been for these thirty years, any Indian savages in New Andalusia.

I use with regret the word *savage*, because it implies a difference of cultivation between the *reduced* Indian, living in the Missions, and the free or independent Indian; a difference which is often belied by fact. In the forests of South America there are tribes of natives, peacefully united in villages, and who render obedience to chiefs.* They cultivate the plantain-tree, cassava, and cotton, on a tolerably extensive tract of ground, and they employ the cotton for weaving hammocks. These people are scarcely more barbarous than the naked Indians of the Missions, who have been taught to make the sign of the cross. It is a common error in Europe, to look on all natives not reduced to a state of subjection, as wanderers and hunters. Agriculture was practised on the American continent long before the arrival of Europeans. It is still practised between the Orinoco and the river Amazon, in lands cleared amidst the forests, places to which the missionaries have never penetrated. It would be to imbibe false ideas respecting the actual condition of the nations of South America, to consider as synonymous the

* These chiefs bear the designations of *Pecannati*, *Apoto*, or *Sibierne*.

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denominations of 'Christian,' 'reduced,' and 'civilized;' and those of 'pagan,' 'savage,' and 'independent.' The reduced Indian is often as little of a Christian as the independent Indian is of an idolater. Both, alike occupied by the wants of the moment, betray a marked indifference for religious sentiments, and a secret tendency to the worship of nature and her powers. This worship belongs to the earliest infancy of nations; it excludes idols, and recognises no other sacred places than grottoes, valleys, and woods.

If the independent Indians have nearly disappeared for a century past northward of the Orinoco and the Apure, that is, from the Snowy Mountains of Merida to the promontory of Paria, it must not thence be concluded, that there are fewer natives at present in those regions, than in the time of the bishop of Chiapa, Bartolomeo de las Casas. In my work on Mexico, I have shown that it is erroneous to regard as a general fact the destruction and diminution of the Indians in the Spanish colonies. There still exist more than six millions of the copper-coloured race, in both Americas; and, though numberless tribes and languages are either extinct, or confounded together, it is beyond a doubt that, within the tropics, in that part of the New World where civilization has penetrated only since the time of Columbus, the number of natives has considerably increased. Two of the Carib villages in the Missions of Piritu or of Carony, contain more families than four or five of the settlements on the Orinoco. The state of society among the Caribbees who have preserved their independence, at the sources of the Essequibo and to the south of the mountains of Pacaraimo, sufficiently proves how much, even among that fine race of men, the population of the Missions exceeds in number that of the free and confederate Caribbees. Besides, the state of the savages of the torrid zone is not like that of the savages of the Missouri. The latter require a vast extent of country, because they live only by hunting; whilst the Indians of Spanish Guiana employ themselves in cultivating cassava and plantains. A very little ground suffices to supply them with food. They do not dread the approach of the whites, like the savages of the United States; who, being progressively driven back behind the Alleghany mountains, the Ohio, and the Mississippi, lose their means of subsistence, in proportion as they find themselves reduced within narrow limits. Under the

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temperate zone, whether in the *provincias internas* of Mexico, or in Kentucky, the contact of European colonists has been fatal to the natives, because that contact is immediate.

These causes have no existence in the greater part of South America. Agriculture, within the tropics, does not require great extent of ground. The whites advance slowly. The religious orders have founded their establishments between the domain of the colonists and the territory of the free Indians. The Missions may be considered as intermediary states. They have doubtless encroached on the liberty of the natives; but they have almost everywhere tended to the increase of population, which is incompatible with the restless life of the independent Indians. As the missionaries advance towards the forests, and gain on the natives, the white colonists in their turn seek to invade in the opposite direction the territory of the Missions. In this protracted struggle, the secular arm continually tends to withdraw the reduced Indian from the monastic hierarchy, and the missionaries are gradually superseded by vicars. The whites, and the castes of mixed blood, favoured by the corregidors, establish themselves among the Indians. The Missions become Spanish villages, and the natives lose even the rememmbrance of their natural language. Such is the progress of civilization from the coasts toward the interior; a slow progress, retarded by the passions of man, but nevertheless sure and steady.

The provinces of New Andalusia and Barcelona, comprehended under the name of Govierno de Cumana, at present include in their population more than fourteen tribes. Those in New Andalusia are the Chaymas, Guayqueries, Pariagotos, Quaquas, Aruacas, Caribbees, and Guaraunos; in the province of Barcelona, Cumanagotos, Palenkas, Caribbees, Piritus, Tomuzas, Topocuares, Chacopatas, and Guarivas. Nine or ten of these fifteen tribes consider themselves to be of races entirely distinct. The exact number of the Guaraunos, who make their huts on the trees at the mouth of the Orinoco, is unknown; the Guayqueries, in the suburbs of Cumana and in the peninsula of Araya, amount to two thousand. Among the other Indian tribes, the Chaymas of the mountains of Caripe, the Caribs of the southern savannahs of New Barcelona, and the Cumanagotos in the Missions of Piritu, are most

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numerous. Some families of Guaraunos have been reduced and dwell in Missions on the left bank of the Orinoco, where the Delta begins. The languages of the Guaraunos and that of the Caribs, of the Cumanagotos and of the Chaymas, are the most general. They seem to belong to the same stock; and they exhibit in their grammatical forms those affinities, which, to use a comparison taken from languages more known, connect the Greek, the German, the Persian, and the Sanscrit.

Notwithstanding these affinities, we must consider the Chaymas, the Guaraunos, the Caribbees, the Quaquas, the Aruacas or Arrawaks, and the Cumanagotos, as different nations. I would not venture to affirm the same of the Guayqueries, the Pariagotos, the Piritus, the Tomuzas, and the Chacopatas. The Guayquerias themselves admit the analogy between their language and that of the Guaraunos. Both are a littoral race, like the Malays of the ancient continent. With respect to the tribes who at present speak the Cumanagota, Caribbean, and Chayma tongues, it is difficult to decide on their first origin, and their relations with other nations formerly more powerful. The historians of the conquest, as well as the ecclesiastics who have described the progress of the Missions, continually confound, like the ancients, geographical denominations with the names of races. They speak of Indians of Cumana and of the coast of Paria, as if the proximity of abode proved the identity of origin. They most commonly even give to tribes the names of their chiefs, or of the mountains or valleys they inhabit. This circumstance, by infinitely multiplying the number of tribes, gives an air of uncertainty to all that the monks relate respecting the heterogeneous elements of which the population of their Missions are composed. How can we now decide, whether the Tomuza and Piritu be of different races, when both speak the Cumanagoto language, which is the prevailing tongue in the western part of the Govierno of Cumana; as the Caribbean and the Chayma are in the southern and eastern parts. A great analogy of physical constitution increases the difficulty of these inquiries. In the new continent a surprising variety of languages is observed among nations of the same origin, and which European travellers scarcely distinguish by their features; while in

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the old continent very different races of men, the Laplanders, the Finlanders, and the Esthonians, the Germanic nations and the Hindoos, the Persians and the Kurds, the Tartar and Mongol tribes, speak languages, the mechanism and roots of which present the greatest analogy.

The Indians of the American Missions are all agriculturists. Excepting those who inhabit the high mountains, they all cultivate the same plants; their huts are arranged in the same manner; their days of labour, their work in the *conuco* of the community; their connexions with the missionaries and the magistrates chosen from among themselves, are all subject to uniform regulations. Nevertheless (and this fact is very remarkable in the history of nations), these analogous circumstances have not effaced the individual features, or the shades of character which distinguish the American tribes. We observe in the men of copper hue, a moral inflexibility, a stedfast perseverance in habits and manners, which, though modified in each tribe, characterise essentially the whole race. These peculiarities are found in every region; from the equator to Hudson's Bay on the one hand, and to the Straits of Magellan on the other. They are connected with the physical organization of the natives, but they are powerfully favoured by the monastic system.

There exist in the missions few villages in which the different families do not belong to different tribes and speak different languages. Societies composed of elements thus heterogeneous are difficult to govern. In general, the monks have united whole nations, or great portions of the same nations, in villages situated near to each other. The natives see only those of their own tribe; for the want of communication, and the isolated state of the people, are essential points in the policy of the missionaries. The reduced Chaymas, Caribs, and Tamanacs, retain their natural physiognomy, whilst they have preserved their languages. If the individuality of man be in some sort reflected in his idioms, these in their turn re-act on his ideas and sentiments. It is this intimate connection between language, character, and physical constitution, which maintains and perpetuates the diversity of nations; that unfailing source of life and motion in the intellectual world.

The missionaries may have prohibited the Indians from following certain practices and observing certain ceremo-

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nies; they may have prevented them from painting their skin, from making incisions on their chins, noses and cheeks; they may have destroyed among the great mass of the people superstitious ideas, mysteriously transmitted from father to son in certain families; but it has been easier for them to proscribe customs and efface remembrances, than to substitute new ideas in the place of the old ones.

The Indian of the Mission is secure of subsistence; and being released from continual struggles against hostile powers, from conflicts with the elements and man, he leads a more monotonous life, less active, and less fitted to inspire energy of mind, than the habits of the wild or independent Indian. He possesses that mildness of character which belongs to the love of repose; not that which arises from sensibility and the emotions of the soul. The sphere of his ideas is not enlarged, where, having no intercourse with the whites, he remains a stranger to those objects with which European civilization has enriched the New World. All his actions seem prompted by the wants of the moment. Taciturn, serious, and absorbed in himself, he assumes a sedate and mysterious air. When a person has resided but a short time in the Missions, and is but little familiarized with the aspect of the natives, he is led to mistake their indolence, and the torpid state of their faculties, for the expression of melancholy, and a meditative turn of mind.

I have dwelt on these features of the Indian character, and on the different modifications which that character exhibits under the government of the missionaries, with the view of rendering more intelligible the observations which form the subject of the present chapter. I shall begin by the nation of the Chaymas, of whom more than fifteen thousand inhabit the Missions above noticed. The Chayma nation, which Father Francisco of Pampeluna* began to reduce to subjection in the middle of the seventeenth century, has the Cumanagotos on the west, the Guaraunos on the east, and the Caribbees on the south. Their territory occupies a space along the elevated mountains of the Cocollar and the Guacharo, the banks of the Guarapiche, of

* The name of this monk, celebrated for his intrepidity, is still revered in the province. He sowed the first seeds of civilization among these mountains. He had long been captain of a ship; and before he became a monk, was known by the name of Tiburtio Redin.

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the Rio Colorado, of the Areo, and of the Caño de Caripe. According to a statistical survey made with great care by the father prefect, there were, in the Missions of the Aragonese Capuchins of Cumana, nineteen *Mission* villages, of which the oldest was established in 1728, containing one thousand four hundred and sixty-five families, and six thousand four hundred and thirty-three persons: sixteen *doctrina* villages, of which the oldest dates from 1660, containing one thousand seven hundred and sixty-six families, and eight thousand one hundred and seventy persons. These Missions suffered greatly in 1681, 1697, and 1720, from the invasions of the Caribbees (then independent), who burnt whole villages. From 1730 to 1736, the population was diminished by the ravages of the small-pox, a disease always more fatal to the copper-coloured Indians than to the whites. Many of the Guaraunos, who had been assembled together, fled back again to their native marshes. Fourteen old Missions were deserted, and have not been rebuilt.

The Chaymas are in general short of stature and thick-set. Their shoulders are extremely broad, and their chests flat. Their limbs are well rounded, and fleshy. Their colour is the same as that of the whole American race, from the cold table-lands of Quito and New Grenada to the burning plains of the Amazon. It is not changed by the varied influence of climate; it is connected with organic peculiarities which for ages past have been unalterably transmitted from generation to generation. If the uniform tint of the skin be redder and more coppery towards the north, it is, on the contrary, among the Chaymas, of a dull brown inclining to tawny. The denomination of copper-coloured men could never have originated in equinoctial America to designate the natives.

The expression of the countenance of the Chaymas, without being hard or stern, has something sedate and gloomy. The forehead is small, and but little prominent, and in several languages of these countries, to express the beauty of a woman, they say that 'she is fat, and has a narrow forehead.' The eyes of the Chaymas are black, deep-set, and very elongated: but they are neither so obliquely placed, nor so small, as in the people of the Mongol race. The corner of the eye is, however, raised up towards the

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temple; the eyebrows are black, or dark brown, thin, and but little arched; the eyelids are edged with very long eyelashes, and the habit of casting them down, as if from lassitude, gives a soft expression to the women, and makes the eye thus veiled appear less than it really is. Though the Chaymas, and in general all the natives of South America and New Spain, resemble the Mongol race in the form of the eye, in their high cheek-bones, their straight and smooth hair, and the almost total absence of beard; yet they essentially differ from them in the form of the nose. In the South Americans this feature is rather long, prominent through its whole length, and broad at the nostrils, the openings of which are directed downward, as with all the nations of the Caucasian race. Their wide mouths, with lips but little protuberant though broad, have generally an expression of good nature. The passage from the nose to the mouth is marked in both sexes by two furrows, which run diverging from the nostrils towards the corners of the mouth. The chin is extremely short and round; and the jaws are remarkable for strength and width.

Though the Chaymas have fine white teeth, like all people who lead a very simple life, they are, however, not so strong as those of the Negroes. The habit of blackening the teeth, from the age of fifteen, by the juices of certain herbs* and caustic lime, attracted the attention of the earliest travellers; but the practice has now fallen quite into disuse. Such have been the migrations of the different tribes in these countries, particularly since the incursions of the Spaniards, who carried on the slave-trade, that it may be inferred the inhabitants of Paria visited by Christopher Columbus and by Ojeda, were not of the same race as the Chaymas. I doubt much whether the custom of blackening the teeth was originally suggested, as Gomara supposed, by absurd notions of beauty, or was practised with the view of preventing the

* The early historians of the conquest state that the blackening of the teeth was effected by the leaves of a tree which the natives called *kay*, and which resembled the myrtle. Among nations very distant from each other, the pimento bears a similar name; among the Haytians *aji* or *ahi*; among the Maypures of the Orinoco, *ai*. Some stimulant and aromatic plants, which mostly belonging to the genus capsicum, were designated by the same name.

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toothache.* This disorder is, however, almost unknown to the Indians; and the whites suffer seldom from it in the Spanish colonies, at least in the warm regions, where the temperature is so uniform. They are more exposed to it on the back of the Cordilleras, at Santa-Fé, and at Popayan.

The Chaymas, like almost all the native nations I have seen, have small, slender hands. Their feet are large, and their toes retain an extraordinary mobility. All the Chaymas have a sort of family look; and this resemblance, so often observed by travellers, is the more striking, as between the ages of twenty and fifty, difference of years is no way denoted by wrinkles of the skin, colour of the hair, or decrepitude of the body. On entering a hut, it is often difficult among adult persons to distinguish the father from the son, and not to confound one generation with another. I attribute this air of family resemblance to two different causes, the local situation of the Indian tribes, and their inferior degree of intellectual culture. Savage nations are subdivided into an infinity of tribes, which, bearing violent hatred one to another, form no intermarriages, even when their languages spring from the same root, and when only a small arm of a river, or a group of hills, separates their habitations. The less numerous the tribes, the more the intermarriages repeated for ages between the same families tend to fix a certain similarity of conformation, an organic type, which may be called national. This type is preserved under the system of the Missions, each Mission being formed by a single horde, and marriages being contracted only between the inhabitants of the same hamlet. Those ties of blood which unite almost a whole nation, are indicated in a simple

* The tribes seen by the Spaniards on the coast of Paria, probably observed the practice of stimulating the organs of taste by caustic lime, as other races employed tobacco, the chimo, the leaves of the coca, or the betel. This practice exists even in our days, but more towards the west, among the Guajiros, at the mouth of the Rio de la Hacha. These Indians, still savage, carry small shells, calcined and powdered, in the husk of a fruit, which serves them as a vessel for various purposes, suspended to their girdle. The powder of the Guajiros is an article of commerce, as was anciently, according to Gomara, that of the Indians of Paria. The immoderate habit of smoking also makes the teeth yellow and blackens them; but would it be just to conclude from this fact, that Europeans smoke because we think yellow teeth handsomer than white?

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manner in the language of the Indians born in the Missions, or by those who, after having been taken from the woods, have learned Spanish. To designate the individuals who belong to the same tribe, they employ the expression *mis parientes*, my relations.

With these causes, common to all isolated classes, and the effects of which are observable among the Jews of Europe, among the different castes of India, and among mountain nations in general, are combined some other causes hitherto unnoticed. I have observed elsewhere, that it is intellectual culture which most contributes to diversify the features. Barbarous nations have a physiognomy of tribe or of horde, rather than individuality of look or features. The savage and civilized man are like those animals of an individual species, some of which roam in the forest, while others, associated with mankind, share the benefits and evils which accompany civilization. Varieties of form and colour are frequent only in domestic animals. How great is the difference, with respect to mobility of features and variety of physiognomy, between dogs which have again returned to the savage state in the New World, and those whose slightest caprices are indulged in the houses of the opulent! Both in men and animals the emotions of the soul are reflected in the features; and the countenance acquires the habit of mobility, in proportion as the emotions of the mind are frequent, varied, and durable. But the Indian of the Missions, being remote from all cultivation, influenced only by his physical wants, satisfying almost without difficulty his desires, in a favoured climate, drags on a dull, monotonous life. The greatest equality prevails among the members of the same community; and this uniformity, this sameness of situation, is pictured on the features of the Indians.

Under the system of the monks, violent passions, such as resentment and anger, agitate the native more rarely than when he lives in the forest. When man in a savage state yields to sudden and impetuous emotions, his physiognomy, till then calm and unruffled, changes instantly to convulsive contortions. His passion is transient in proportion to its violence. With the Indians of the Missions, as I have often observed on the Orinoco, anger is less violent, less earnest, but of longer duration. Besides, in every con-

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dition of man, it is not the energetic or the transient outbreaks of the passions, which give expression to the features, it is rather that sensibility of the soul, which brings us continually into contact with the external world, multiplies our sufferings and our pleasures, and re-acts at once on the physiognomy, the manners, and the language. If the variety and mobility of the features embellish the domain of animated nature, we must admit also, that both increase by civilization, without being solely produced by it. In the great family of nations, no other race unites these advantages in so high a degree as the Caucasian or European. It is only in white men that the instantaneous penetration of the dermoidal system by the blood can produce that slight change of the colour of the skin which adds so powerful an expression to the emotions of the soul. "How can those be trusted who know not how to blush?" says the European, in his dislike of the Negro and the Indian. We must also admit, that immobility of features is not peculiar to every race of men of dark complexion: it is much less marked in the African than in the natives of America.

The Chaymas, like all savage people who dwell in excessively hot regions, have an insuperable aversion to clothing. The writers of the middle ages inform us, that in the north of Europe, articles of clothing distributed by missionaries, greatly contributed to the conversion of the pagan. In the torrid zone, on the contrary, the natives are ashamed (as they say) to be clothed; and flee to the woods, when they are compelled to cover themselves. Among the Chaymas, in spite of the remonstrances of the monks, men and women remain unclothed within their houses. When they go into the villages they put on a kind of tunic of cotton, which scarcely reaches to the knees. The men's tunics have sleeves; but women, and young boys to the age of ten or twelve, have the arms, shoulders, and upper part of the breast uncovered. The tunic is so shaped, that the forepart is joined to the back by two narrow bands, which cross the shoulders. When we met the natives, out of the boundaries of the Mission, we saw them, especially in rainy weather, stripped of their clothes, and holding their shirts rolled up under their arms. They preferred letting the rain fall on their bodies to wetting their clothes. The elder

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women hid themselves behind trees, and burst into loud fits of laughter when they saw us pass. The missionaries complain that in general the young girls are not more alive to feelings of decency than the men. Ferdinand Columbus* relates that, in 1498, his father found the women in the island of Trinidad without any clothing; while the men wore the *guayuco*, which is rather a narrow bandage than an apron. At the same period, on the coast of Paria, young girls were distinguished from married women, either, as Cardinal Bembo states, by being quite unclothed, or, according to Gomara, by the colour of the *guayuco*. This bandage, which is still in use among the Chaymas, and all the naked nations of the Orinoco, is only two or three inches broad, and is tied on both sides to a string which encircles the waist. Girls are often married at the age of twelve; and until they are nine years old, the missionaries allow them to go to church unclothed, that is to say, without a tunic. Among the Chaymas, as well as in all the Spanish Missions and the Indian villages, a pair of drawers a pair of shoes, or a hat, are objects of luxury unknown to the natives. An Indian servant, who had been with us during our journey to Caripe and the Orinoco, and whom I brought to France, was so much struck, on landing, when he saw the ground tilled by a peasant with his hat on, that he thought himself in a miserable country, where even the nobles (los mismos caballeros) followed the plough. The Chayma women are not handsome, according to the ideas we annex to beauty; yet the young girls have a look of softness and melancholy, contrasting agreeably with the expression of the mouth, which is somewhat harsh and wild. They wear their hair plaited in two long tresses; they do not paint their skin; and wear no other ornaments than necklaces and bracelets made of shells, birds' bones, and seeds. Both men and women are very muscular, but at the same time fleshy and plump. I saw no person who had any natural

* Life of the Adelantado: Churchill's Collection, 1723. This Life, written after the year 1537, from original notes in the handwriting of Christopher Columbus himself, is the most valuable record of the history of his discoveries. It exists only in the Italian and Spanish translations of Alphonso de Ulloa and Gonzales Barcia; for the original, carried to Venice in 1571 by the learned Fornari, has not been published, and is supposed to be lost. 'Napione della Patria di Colombo,'—1804. 'Cancellieri sopra Christ. Colombo,'—1809.

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deformity; and I may say the same of thousands of Caribs, Muyscas, and Mexican and Peruvian Indians, whom we observed during the course of five years. Bodily deformities, and deviations from nature, are exceedingly rare among certain races of men, especially those who have the epidermis highly coloured; but I cannot believe that they depend solely on the progress of civilization, a luxurious life, or the corruption of morals. In Europe a deformed or very ugly girl marries, if she happen to have a fortune, and the children often inherit the deformity of the mother. In the savage state, which is a state of equality, no consideration can induce a man to unite himself to a deformed woman, or one who is very unhealthy. Such a woman, if she resist the accidents of a restless and troubled life, dies without children. We might be tempted to think, that savages all appear well-made and vigorous, because feeble children die young for want of care, and only the strongest survive; but these causes cannot operate among the Indians of the Missions, whose manners are like those of our peasants, or among the Mexicans of Cholula and Tlascala, who enjoy wealth, transmitted to them by ancestors more civilized than themselves. If, in every state of cultivation, the copper-coloured race manifests the same inflexibility, the same resistance to deviation from a primitive type, are we not forced to admit that this peculiarity belongs in great measure to hereditary organization, to that which constitutes the race? With copper-coloured men, as with whites, luxury and effeminacy weaken the physical constitution, and heretofore deformities were more common at Cuzco and Tenochtitlan. Among the Mexicans of the present day, who are all labourers, leading the most simple lives, Montezuma would not have found those dwarfs and humpbacks whom Bernal Diaz saw waiting at his table when he dined.* The custom of marrying very young, according to the testimony of the monks, is no way detrimental to population. This precocious nubility depends on the race, and not on the influence of a climate excessively warm. It is found on the north-west coast of America, among the Esquimaux, and in Asia, among the Kamtschatdales, and the Koriaks, where girls of ten years old are often mothers. It may appear astonishing, that the time of gesta-

* Bernal Diaz, Hist. Verd. de la Nueva España, 1630.

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tion—the duration of pregnancy, never alters in a state of health, in any race, or in any climate.

The Chaymas are almost without beard on the chin, like the Tungouses, and other nations of the Mongol race. They pluck out the few hairs which appear; but independently of that practice, most of the natives would be nearly beardless.* I say most of them, because there are tribes which, as they appear distinct from the others, are more worthy of fixing our attention. Such are, in North America, the Chippewas visited by Mackenzie, and the Yabipaees, near the Toltec ruins at Moqui, with bushy beards; in South America, the Patagonians and the Guaraunos. Among these last are some who have hairs on the breast. When the Chaymas, instead of extracting the little hair they have on the chin, attempt to shave themselves frequently, their beards grow. I have seen this experiment tried with success by young Indians, who officiated at mass, and who anxiously wished to resemble the Capuchin fathers, their missionaries and masters. The great mass of the people, however, dislike the beard, no less than the Eastern nations hold it in reverence. This antipathy is derived from the same source as the predilection for flat foreheads, which is evinced in so singular a manner in the statues of the Aztec heroes and divinities. Nations attach the idea of beauty to everything which particularly characterizes their own physical conformation, their national physiognomy.† Hence it ensues that among a people to whom Nature has given very little beard, a narrow forehead, and a brownish red skin, every individual thinks himself handsome in proportion as his body is destitute of hair, his head flattened, and his skin besmeared with *annatto, chica*, or some other copper-red colour.

The Chaymas lead a life of singular uniformity. They go to rest very regularly at seven in the evening, and rise long before daylight, at half-past four in the morning. Every

* Physiologists would never have entertained any difference of opinion respecting the existence of the beard among the Americans, if they had considered what the first historians of the Conquest have said on this subject; for example, Pigafetta, in 1519, in his journal, preserved in the Ambrosian Library at Milan, and published (in 1800) by Amoretti; Benzoni, Hist. del Mundo Nuovo, 1572; Bembo, Hist. Venet., 1557.

† Thus, in their finest statues, the Greeks exaggerated the form of the forehead, by elevating beyond proportion the facial line.

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Indian has a fire near his hammock. The women are so chilly, that I have seen them shiver at church when the centigrade thermometer was not below 18°. The huts of the Indians are extremely clean. Their hammocks, their reed mats, their pots for holding cassava and fermented maize, their bows and arrows, everything is arranged in the greatest order. Men and women bathe every day; and being almost constantly unclothed, they are exempted from that uncleanliness, of which the garments are the principal cause among the lower class of people in cold countries. Besides a house in the village, they have generally, in their *conucos*, near some spring, or at the entrance of some solitary valley, a small hut, covered with the leaves of the palm or plantain-tree. Though they live less commodiously in the conuco, they love to retire thither as often as they can. The irresistible desire the Indians have to flee from society, and enter again on a nomade life, causes even young children sometimes to leave their parents, and wander four or five days in the forests, living on fruits, palm-cabbage, and roots. When travelling in the Missions, it is not uncommon to find whole villages almost deserted, because the inhabitants are in their gardens, or in the forests (al monte). Among civilized nations, the passion for hunting arises perhaps in part from the same causes: the charm of solitude, the innate desire of independence, the deep impression made by Nature, whenever man finds himself in contact with her in solitude.

The condition of the women among the Chaymas, like that in all semi-barbarous nations, is a state of privation and suffering. The hardest labour devolves on them. When we saw the Chaymas return in the evening from their gardens, the man carried nothing but the knife or hatchet (machete), with which he clears his way among the underwood; whilst the woman, bending under a great load of plantains, carried one child in her arms, and sometimes two other children placed upon the load. Notwithstanding this inequality of condition, the wives of the Indians of South America appear to be in general happier than those of the savages of the North. Between the Alleghany mountains and the Mississippi, wherever the natives do not live chiefly on the produce of the chase, the women cultivate maize, beans, and gourds; and the men take no share in the labours of the field. In

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the torrid zone, hunting tribes are not numerous, and in the Missions, the men work in the fields as well as the women.

Nothing can exceed the difficulty experienced by the Indians in learning Spanish, to which language they have an absolute aversion. Whilst living separate from the whites, they have no ambition to be called educated Indians, or, to borrow the phrase employed in the Missions, 'latinized Indians' (Indios muy latinos). Not only among the Chaymas, but in all the very remote Missions which I afterwards visited, I observed that the Indians experience vast difficulty in arranging and expressing the most simple ideas in Spanish, even when they perfectly understand the meaning of the words and the turn of the phrases. When a European questions them concerning objects which have surrounded them from their cradles, they seem to manifest an imbecility exceeding that of infancy. The missionaries assert that this embarrassment is neither the effect of timidity nor of natural stupidity, but that it arises from the impediments they meet with in the structure of a language so different from their native tongue. In proportion as man is remote from cultivation, the greater is his mental inaptitude. It is not, therefore, surprising that the isolated Indians in the Missions should experience in the acquisition of the Spanish language, less facility than Indians who live among mestizoes, mulattoes, and whites, in the neighbourhood of towns. Nevertheless, I have often wondered at the volubility with which, at Caripe, the native alcalde, the governador, and the sergento mayor, will harangue for whole hours the Indians assembled before the church; regulating the labours of the week, reprimanding the idle, or threatening the disobedient. Those chiefs who are also of the Chayma race, and who transmit the orders of the missionary, speak all together in a loud voice, with marked emphasis, but almost without action. Their features remain motionless; but their look is imperious and severe.

These same men, who manifest quickness of intellect, and who were tolerably well acquainted with the Spanish, were unable to connect their ideas, when, in our excursions in the country around the convent, we put questions to them through the intervention of the monks. They were made to

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affirm or deny whatever the monks pleased: and that wily civility, to which the least cultivated Indian is no stranger, induced them sometimes to give to their answers the turn that seemed to be suggested by our questions. Travellers cannot be enough on their guard against this officious assent, when they seek to confirm their own opinions by the testimony of the natives. To put an Indian alcalde to the proof, I asked him one day, whether he did not think the little river of Caripe, which issues from the cavern of the Guacharo, returned into it on the opposite side by some unknown entrance, after having ascended the slope of the mountain. The Indian seemed gravely to reflect on the subject, and then answered, by way of supporting my hypothesis: "How else, if it were not so, would there always be water in the bed of the river at the mouth of the cavern?"

The Chaymas are very dull in comprehending anything relating to numerical facts. I never knew one of these people who might not have been made to say that he was either eighteen or sixty years of age. Mr. Marsden observed the same peculiarity in the Malays of Sumatra, though they have been civilized more than five centuries. The Chayma language contains words which express pretty large numbers, yet few Indians know how to apply them; and having felt, from their intercourse with the missionaries, the necessity of so doing, the more intelligent among them count in Spanish, but apparently with great effort of mind, as far as thirty, or perhaps fifty. The same persons, however, cannot count in the Chayma language beyond five or six. It is natural that they should employ in preference the words of a language in which they have been taught the series of units and tens. Since learned Europeans have not disdained to study the structure of the idioms of America with the same care as they study those of the Semitic languages, and of the Greek and Latin, they no longer attribute to the imperfection of a language, what belongs to the rudeness of the nation. It is acknowledged, that almost everywhere the Indian idioms display greater richness, and more delicate gradations, than might be supposed from the uncultivated state of the people by whom they are spoken. I am far from placing the languages of the New World in the same rank with the finest languages of Asia

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and Europe; but no one of these latter has a more neat, regular, and simple system of numeration, than the Quichua and the Aztec, which were spoken in the great empires of Cuzco and Anahuac. It is a mistake to suppose that those languages do not admit of counting beyond four, because in villages where they are spoken by the poor labourers of Peruvian and Mexican race, individuals are found, who cannot count beyond that number. The singular opinion, that so many American nations reckon only as far as five, ten, or twenty, has been propagated by travellers, who have not reflected, that, according to the genius of different idioms, men of all nations stop at groups of five, ten, or twenty units (that is, the number of the fingers of one hand, or of both hands, or of the fingers and toes together); and that six, thirteen, or twenty are differently expressed, by five-one, ten-three, and feet-ten.* Can it be said that the numbers of the Europeans do not extend beyond ten, because we stop after having formed a group of ten units?

The construction of the languages of America is so opposite to that of the languages derived from the Latin, that the Jesuits, who had thoroughly examined everything that could contribute to extend their establishments, introduced among their neophytes, instead of the Spanish, some Indian tongues, remarkable for their regularity and copiousness, such as the Quichua and the Guarani. They endeavoured to substitute these languages for others which were poorer and more irregular in their syntax. This substitution was found easy: the Indians of the different tribes adopted it with docility, and thenceforward those American languages generalized became a ready medium of communication between the missionaries and the neophytes. It would be a mistake to suppose, that the preference given to the language of the Incas over the Spanish tongue had no other aim than that of isolating the Missions, and withdrawing them from the influence of two rival powers, the bishops and civil governors. The Jesuits had other motives, independently of their policy, for wishing to generalize certain Indian tongues. They found in those languages a common

* Savages, to express great numbers with more facility, are in the habit of forming groups of five, ten, or twenty grains of maize, according as they reckon in their language by fives, tens, or twenties.

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tie, easy to be established between the numerous hordes which had remained hostile to each other, and had been kept asunder by diversity of idioms; for, in uncultivated countries, after the lapse of several ages, dialects often assume the form, or at least the appearance, of mother-tongues.

When it is said that a Dane learns the German, and a Spaniard the Italian or the Latin, more easily than they learn any other language, it is at first thought that this facility results from the identity of a great number of roots, common to all the Germanic tongues, or to those of Latin Europe; it is not considered, that, with this resemblance of sounds, there is another resemblance, which acts more powerfully on nations of a common origin. Language is not the result of an arbitrary convention. The mechanism of inflections, the grammatical constructions, the possibility of inversions, all are the offspring of our own minds, of our individual organization. There is in man an instinctive and regulating principle, differently modified among nations not of the same race. A climate more or less severe, a residence in the defiles of mountains, or on the sea-coasts, or different habits of life, may alter the pronunciation, render the identity of the roots obscure, and multiply the number; but all these causes do not affect that which constitutes the structure and mechanism of languages. The influence of climate, and of external circumstances, vanishes before the influence which depends on the race, on the hereditary and individual dispositions of men.

In America (and this result of recent researches * is extremely important with respect to the history of our species) from the country of the Esquimaux to the banks of the Orinoco, and again from these torrid regions to the frozen climate of the Straits of Magellan, mother-tongues, entirely different in their roots, have, if we may use the expression, the same physiognomy. Striking analogies of grammatical construction are acknowledged, not only in the more perfect languages, as in that of the Incas, the Aymara, the Guarauno, the Mexican, and the Cora, but also in languages extremely rude. Idioms, the roots of which do not resemble each other more than the

* See Vater's Mithridates.

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roots of the Sclavonic and the Biscayan, have those resemblances of internal mechanism which are found in the Sanscrit, the Persian, the Greek, and the German languages. Almost everywhere in the New World we recognize a multiplicity of forms and tenses in the verb,* an ingenious method of indicating beforehand, either by inflexion of the personal pronouns, which form the terminations of the verb, or by an intercalated suffix, the nature and the relation of its object and its subject, and of distinguishing whether the object be animate or inanimate, of the masculine or the feminine gender, simple or in complex number. It is on account of this general analogy of structure,—it is because American languages which have no words in common (for instance, the Mexican and the Quichua), resemble each other by their organization, and form complete contrasts to the languages of Latin Europe, that the Indians of the Missions familiarize themselves more easily with an American idiom than with the Spanish. In the forests of the Orinoco I have seen the rudest Indians speak two or three tongues. Savages of different nations often communicate their ideas to each other by an idiom not their own.

If the system of the Jesuits had been followed, languages, which already occupy a vast extent of country, would have become almost general. In Terra Firma and on the Orinoco, the Caribbean and the Tamanac alone would now be spoken;

* In the Greenland language, for example, the multiplicity of the pronouns governed by the verb produces twenty-seven forms for every tense of the Indicative mood. It is surprising to find, among nations now ranking in the lowest degree of civilization, this desire of graduating the relations of time, this superabundance of modifications introduced into the verb, to characterise the object. *Matarpa*, he takes it away: *mattarpet*, thou takest it away: *mattarpatit*, he takes it away from thee: *mattarpagit*, I take away from thee. And in the preterite of the same verb, *mattara*, he has taken it away: *mattaratit*, he has taken it away from thee. This example from the Greenland language shows how the governed and the personal pronouns form one compound, in the American languages, with the root of the verb. These slight differences in the form of the verb, according to the nature of the pronouns governed by it, is found in the Old World only in the Biscayan and Congo languages (Vater, Mithridates. William von Humboldt, On the Basque Language). Strange conformity in the structure of languages on spots so distant, and among three races of men so different,—the white Catalonians, the black Congos, and the copper-coloured Americans!

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and in the south and south-west, the Quichua, the Guarano, the Omagua, and the Araucan. By appropriating to themselves these languages, the grammatical forms of which are very regular, and almost as fixed as those of the Greek and Sanscrit, the missionaries would place themselves in more intimate connection with the natives whom they govern. The numberless difficulties which occur in the system of a Mission consisting of Indians of ten or a dozen different nations would disappear with the confusion of idioms. Those which are little diffused would become dead languages; but the Indian, in preserving an American idiom, would retain his individuality—his national character. Thus by peaceful means might be effected what the Incas began to establish by force of arms.

How indeed can we be surprised at the little progress made by the Chaymas, the Caribbees, the Salives, or the Otomacs, in the knowledge of the Spanish language, when we recollect that one white man, one single missionary, finds himself alone amidst five or six hundred Indians? and that it is difficult for him to establish among them a governador, an alcalde, or a fiscal, who may serve him as an interpreter? If, instead of the missionary system, some other means of civilization were substituted, if, instead of keeping the whites at a distance, they could be mingled with the natives recently united in villages, the American idioms would soon be superseded by the languages of Europe, and the natives would receive in those languages the great mass of new ideas which are the fruit of civilization. Then the introduction of general tongues, such as that of the Incas, or the Guaranos, without doubt would become useless. But after having lived so long in the Missions of South America, after having so closely observed the advantages and the abuses of the system of the missionaries, I may be permitted to doubt whether that system could be easily abandoned, though it is doubtless very capable of being improved, and rendered more conformable with our ideas of civil liberty. To this it may be answered, that the Romans* succeeded in rapidly

* For the reason of this rapid introduction of Latin among the Gauls, I believe we must look into the character of the natives and the state of their civilization, and not into the structure of their language. The brown-haired Celtic nations were certainly different from the race of

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introducing their language with their sovereignty into the country of the Gauls, into Bœtica, and into the province of Africa. But the natives of these countries were not savages; —they inhabited towns; they were acquainted with the use of money; and they possessed institutions denoting a tolerably advanced state of cultivation. The allurement of commerce, and a long abode of the Roman legions, had promoted intercourse between them and their conquerors. We see, on the contrary, that the introduction of the languages of the mother-countries was met by obstacles almost innumerable, wherever Carthaginian, Greek, or Roman colonies were established on coasts entirely barbarous. In every age, and in every climate, the first impulse of the savage is to shun the civilized man.

The language of the Chayma Indians was less agreeable to my ear than the Caribbee, the Salive, and other languages of the Orinoco. It has fewer sonorous terminations in accented vowels. We are struck with the frequent repetition of the syllables *guaz*, *ez*, *puec*, and *pur*. These terminations are derived in part from the inflexion of the verb *to be*, and from certain prepositions, which are added at the ends of words, and which, according to the genius of the American idioms, are incorporated with them. It would be wrong to attribute this harshness of sound to the abode of the Chaymas in the mountains. They are strangers to that temprate climate. They have been led thither by the missionaries; and it is well known that, like all the inhabitants of warm regions, they at first dreaded what they called the cold of Caripe. I employed myself, with M. Bonpland, during our abode at the hospital of the Capuchins, in forming a small catalogue of Chayma words. I am aware that languages are much more strongly characterised by their structure and grammatical forms than by the analogy of their sounds and of their roots; and that the analogy of sounds is sometimes

the light-haired Germanic nations; and though the Druid caste recalls to our minds one of the institutions of the Ganges, this does not demonstrate that the idiom of the Celts belongs, like that of the nations of Odin, to a branch of the Indo-Pelasgic languages. From analogy of structure and of roots, the Latin ought to have penetrated more easily on the other side of the Danube, than into Gaul; but an uncultivated state, joined to great moral inflexibility, probably opposed its introduction among the Germanic nations.

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so disguised in different dialects of the same tongue, as not to be recognizable; for the tribes into which a nation is divided, often designate the same objects by words altogether heterogeneous. Hence it follows that we readily fall into mistakes, if, neglecting the study of the inflexions, and consulting only the roots (for instance, in the words which designate the moon, sky, water, and earth), we decide on the absolute difference of two idioms from the mére want of resemblance in sounds. But, while aware of this source of error, travellers would do well to continue to collect such materials as may be within their reach. If they do not make known the internal structure, and general arrangement of the edifice, they may point out some important parts.

The three languages now most used in the provinces of Cumana and Barcelona, are the Chayma, the Cumanagota, and the Caribbee. They have always been regarded in these countries as different idioms, and a dictionary of each has been written for the use of the Missions, by Fathers Tauste, Ruiz-blanco, and Breton. The *Vocabulario y Arte de la Lengua de los Indios Chaymas* has become extremely scarce. The few American grammars, printed for the most part in the seventeenth century, passed into the Missions, and have been lost in the forests. The dampness of the air and the voracity of insects* render the preservation of books almost impossible in those regions: they are destroyed in a short space of time, notwithstanding every precaution that may be employed. I had much difficulty to collect in the Missions, and in the convents, those grammars of American languages, which, on my return to Europe, I placed in the hands of Severin Vater, professor and librarian at the university of Königsberg. They furnished him with useful materials for his great work on the idioms of the New World. I omitted, at the time, to transcribe from my journal, and communicate to that learned gentleman, what I had collected in the Chayma tongue. Since neither Father Gili, nor the Abbé Hervas, has mentioned this language, I shall here explain succinctly the result of my researches.

On the right bank of the Orinoco, south-east of the Mis-

* The termites, so well known in Spanish America under the name of *comegen*, or 'devourer,' is one of these destructive insects.

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sion of Encaramada, and at the distance of more than a hundred leagues from the Chaymas, live the Tamanacs (Tamanacu), whose language is divided into several dialects. This nation, formerly very powerful, is separated from the mountains of Caripe by the Orinoco, by the vast steppes of Caracas and of Cumana; and by a barrier far more difficult to surmount, the nations of Caribbean origin. But notwithstanding distance, and the numerous obstacles in the way of intercourse, the language of the Chayma Indians is a branch of the Tamanac tongue. The oldest missionaries of Caripe are ignorant of this curious fact, because the Capuchins of Aragon seldom visit the southern banks of the Orinoco, and scarcely know of the existence of the Tamanacs. I recognized the analogy between the idiom of this nation, and that of the Chayma Indians long after my return to Europe, in comparing the materials which I had collected with the sketch of a grammar published in Italy by an old missionary of the Orinoco. Without knowing the Chaymas, the Abbé Gili conjectured that the language of the inhabitants of Paria must have some relation to the Tamanac.*

I will prove this connection by two means which serve to show the analogy of idioms; viz., the grammatical construction, and the identity of words and roots. The following are the personal pronouns of the Chaymas, which are

* Vater has also advanced some well-founded conjectures on the connexion between the Tamanac and Caribbean tongues and those spoken on the north-east coast of South America. I may acquaint the reader, that I have written the words of the American languages according to the Spanish orthography, so that the *u* should be pronounced *oo*, the *ch* like *ch* in English, &c. Having during a great number of years spoken no other language than the Castilian, I marked down the sounds according to the orthography of that language, and now I am afraid of changing the value of these signs, by substituting others no less imperfect. It is a barbarous practice, to express, like the greater part of the nations of Europe, the most simple and distinct sounds by many vowels, or many united consonants, while they might be indicated by letters equally simple. What a chaos is exhibited by the vocabularies written according to English, German, French, or Spanish notations! A new essay, which the illustrious author of the travels in Egypt, M. Volney, is about to publish on the analysis of sounds found in different nations, and on the notation of those sounds according to a uniform system, will lead to great progress in the study of languages.

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at the same time possessive pronouns; *u-re*, I, me; *eu-re*, thou, thee; *teu-re*, he, him. In the Tamanac, *u-re*, I; *amare* or *anja*, thou; *iteu-ja*, he. The radical of the first and of third person is in the Chayma *u* and *teu*.* The same roots are found in the Tamanac.

CHAYMA.	TAMANAC.
Ure, I.	*Ure*.
Tuna, water.	*Tuna*.
Conopo, rain.†	*Canepo*.
Poturu, to know.	*Puturu*.
Apoto, fire.	*Uapto* (in Caribbean *uato*).
Nuna, the moon, a month.	*Nuna*.‡
Je, a tree.	*Jeje*.
Ata, a house.	*Aute*.
Euya, to you.	*Auya*.
Teya, to you.	*Iteuya*.
Guane, honey.	*Uane*.
Nacaramayre, he has said it.	*Nacaramai*.
Piache, a physician, a sorcerer.	*Psiache*.
Tibin, one.	*Obin* (in Jaoi, *Tewin*).
Aco, two.	*Oco* (in Caribbean, *Oeco*).
Orua, two.	*Orua* (in Caribbean, *Oroa*).
Pun, flesh.	*Punu*.
Pra, no (negation).	*Pra*.

The verb *to be*, is expressed in Chayma by *az*. On adding to the verb the personal pronoun *I* (*u* from *u-re*), a *g* is placed, for the sake of euphony, before the *u*, as in *guaz*, 'I am,' properly *g-u-az*. As the first person is known by an *u*,

* We must not wonder at those roots which reduce themselves to a single vowel. In a language of the Old Continent, the structure of which is so artificially complicated, (the Biscayan,) the family name *Ugarte* (between the waters) contains the *u* of *ura* (water) and *arte* between. The *g* is added for the sake of euphony.

† The same word, *conopo*, signifies *rain* and *year*. The years are counted by the number of winters, or rainy seasons. They say in Chayma, as in Sanscrit, 'so many rains,' meaning so many years. In the Basque language, the word *urtea*, year, is derived from *urten*, to bring forth leaves in spring.

‡ In the Tamanac and Caribbean languages, *Nono* signifies the earth, *Nuna* the moon; as in the Chayma. This affinity appears to me very curious; and the Indians of the Rio Caura say, that the moon is 'another earth.' Among savage nations, amidst so many confused ideas, we find certain reminiscences well worthy of attention. Among the Greenlanders *Nuna* signifies the earth, and *Ananingat* the moon.

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the second is designated by an *m*, the third by an *i*; *maz*, 'thou art;' *muerepuec araquapemaz?* 'why art thou sad?' properly 'what for sad thou art;' *punpuec topuchemaz*, 'thou art fat in body,' properly 'flesh (*pun*) for (*puec*) fat (*topuche*) thou art (*maz*).' The possessive pronouns precede the substantive; *upatay*, 'in my house,' properly 'my house in.' All the prepositions and the negation *pra* are incorporated at the end, as in the Tamanac. They say in Chayma, *ipuec*, 'with him,' properly 'him with;' *euya*, 'to thee,' or 'thee to;' *epuec charpe guaz*, 'I am gay with thee,' properly 'thee with gay I am;' *ucarepra*, 'not as I,' properly 'I as not;' *quenpotupra quoguaz*, 'I do not know him,' properly 'him knowing not I am;' *quenepra quoguaz*, 'I have not seen him,' properly 'him seeing not I am.' In the Tamanac tongue, *acurivane* means 'beautiful,' and *acurivanepra*, 'ugly—not beautiful;' *outapra*, 'there is no fish,' properly 'fish none;' *uteripipra*, 'I will not go,' properly 'I to go will not,' composed of *uteri*,* 'to go,' *ipiri*, 'to choose,' and *pra*, 'not.' Among the Caribbees, whose language also bears some relation to the Tamanac, though infinitely less than the Chayma, the negation is expressed by an *m* placed before the verb: *amoyenlengati*, 'it is very cold;' and *mamoyenlengati*, 'it is not very cold.' In an analogous manner, the particle *mna* added to the Tamanac verb, not at the end, but by intercalation, gives it a negative sense, as *taro*, 'to say,' *taromnar*, 'not to say.'

The verb *to be*, very irregular in all languages, is *az* or *ats* in Chayma; and *uochiri* (in composition *uac*, *uatscha*) in Tamanac. It serves not only to form the Passive, but it is added also, as by agglutination, to the radical of attributive verbs, in a number of tenses.† These agglu-

* In Chayma: *utechire*, 'I will go also,' properly *I* (*u*) to go (the radical *ute*, or, because of the preceding vowel, *te*) also (*chere*, or *ere*, or *ire*). In *utechire* we find the Tamanac verb 'to go,' *uteri*, of which *ute* is also the radical, and *ri* the termination of the Infinitive. In order to show that in Chayma *chere* or *ere* indicates the adverb 'also,' I shall cite from the fragment of a vocabulary in my possession, *u-chere*, 'I also;' *nacaramayre*, 'he said so also;' *guarzazere*, 'I carried also;' *charechere*, 'to carry also.' In the Tamanac, as in the Chayma, *chareri* signifies 'to carry.'

† The present in the Tamanac, *jarer-bac-ure*, appears to me nothing else than the verb *bac*, or *uac* (from *uacschiri*, 'to be'), added to the

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tinations remind us of the employment in the Sanscrit of the auxiliary verbs *as* and *bhu* (*asti* and *bhavati**); the Latin, of *es* and *fu*, or *fus*;† the Biscayan, of *izan*, *ucan*, and *eguin*. There are certain points in which idioms the most dissimilar concur one with another. That which is common in the intellectual organization of man is reflected in the general structure of language; and every idiom, however barbarous it may appear, discloses a regulating principle which has presided at its formation.

The plural, in Tamanac, is indicated in seven different ways, according to the termination of the substantive, or according as it designates an animate or inanimate object.‡ In Chayma the plural is formed as in Caribbee, in *on; teure*, 'himself,' *teurecon*, 'themselves;' *tanorocon*, 'those here;' *montaonocon*, 'those below,' supposing that the interlocutor is speaking of a place where he was himself present; *miyonocon*, 'those below,' supposing he speaks of a place where he was not present. The Chaymas have also the Castilian adverbs *aquí* and *allá*, shades of difference which can be expressed only by periphrasis, in the idioms of Germanic and Latin origin.

Some Indians, who were acquainted with Spanish, assured us, that *zis* signified not only the sun, but also the Deity. This appeared to me the more extraordinary, as among all other American nations we find distinct words for God and the sun. The Carib does not confound *Tamoussicabo*, 'the Ancient of Heaven,' with *veyou*, 'the sun.' Even the Peruvian, though a worshipper of the sun, raises his mind to the idea of a Being who regulates the movements of the stars. The sun, in the language of the Incas, bears

radical 'to carry,' *jare* (in the infinitive *jareri*), the result of which is 'carrying to be I.'

* In the branch of the Germanic languages we find *bhu* under the forms *bim*, *bist*; *as*, in the forms *vas*, *vast*, *vesum* (Bopp, p. 138).

† Hence *fu-ero*; *amav-issem*; *amav-eram*; *pos-sum* (*pot-sum*).

‡ *Tamanacu*, 'a Tamanac' (plur. *Tamanakemi*): *Pongheme*, a Spaniard (properly 'a man clothed'); *Pongamo*, Spaniards, or 'men clothed.' The plural in *cne* characterizes inanimate objects: for example, *cene*, 'a thing;' *cenecne*, 'things:' *jeje*, 'a tree;' *jejecne*, 'trees.'

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the name of *inti*,* nearly the same as in Sanscrit; while God is called *Vinay Huayna*, 'the eternally young.' †

The arrangement of words in the Chayma is similar to that found in all the languages of both continents, which have preserved a certain primitive character. The object is placed before the verb, the verb before the personal pronoun. The object, on which the attention should be principally fixed, precedes all the modifications of that object. The American would say, 'liberty complete love we,' instead of 'we love complete liberty;' 'Thee with happy am I,' instead of 'I am happy with thee.' There is something direct, firm, demonstrative, in these turns, the simplicity of which is augmented by the absence of the article. May it be presumed that, with advancing civilization, these nations, left to themselves, would have gradually changed the arrangement of their phrases? We are led to adopt this idea, when we reflect on the changes which the syntax of the Romans has undergone in the precise, clear, but somewhat timid languages of Latin Europe.

The Chayma, like the Tamanac and most of the American languages, is entirely destitute of certain letters, as *f*, *b*, and *d*. No word begins with an *l*. The same observation has been made on the Mexican tongue, though it is overcharged with the syllables *tli*, *tla*, and *itl*, at the end or in the middle of words. The Chaymas substitute *r* for *l*; a substitution that arises from a defect of pronunciation common in every zone.‡ Thus, the Caribbees of the Orinoco have been transformed into *Galibi* in French Guiana by confounding *r* with *l*, and softening the *c*. The Tamanac has made *choraro* and *solalo* of the Spanish word *soldado* (soldier). The disappearance of the *f* and *b* in so many American idioms arises out of that intimate connection between certain sounds, which is manifested in all lan-

* In the Quichua, or language of the Incas, the sun is *inti*; love, *munay*; great, *veypul*; in Sanscrit, the sun, *indre*; love, *manya*; great, *vipulo*. (Vater, Mithridates, tom. iii. p. 333.) These are the only examples of analogy of sound, that have yet been noticed. The grammatical character of the two languages is totally different.

† *Vinay*, 'always,' or 'eternal;' *huayna*, 'in the flower of age.'

‡ For example, the substitution of *r* for *l*, characterizes the Bashmuric dialect of the Coptic language.

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guages of the same origin. The letters *f*, *v*, *b*, and *p*, are substituted one for the other; for instance, in the Persian, *peder*, father (pater); *burader*,* brother (frater); *behar*, spring (ver); in Greek, *φόρτον* (forton), a burthen; *ποῦς* (pous) a foot, (fuss, Germ.). In the same manner, with the Americans, *f* and *b* become *p;* and *d* becomes *t*. The Chayma pronounces *patre*, *Tios*, *Atani*, *aracapucha*, for *padre*, *Dios*, *Adan*, and *arcabuz* (harquebuss).

In spite of the relations just pointed out, I do not think that the Chayma language can be regarded as a dialect of the Tamanac, as the Maitano, Cuchivero, and Crataima undoubtedly are. There are many essential differences; and between the two languages there appears to me to exist merely the same connection as is found in the German, the Swedish, and the English. They belong to the same subdivision of the great family of the Tamanac, Caribbean, and Arowak tongues. As there exists no absolute measure of resemblance between idioms, the degrees of parentage can be indicated only by examples taken from known tongues. We consider those as being of the same family, which bear affinity one to the other, as the Greek, the German, the Persian, and the Sanscrit.

Some philologists have imagined, on comparing languages, that they may all be divided into two classes, of which some, comparatively perfect in their organization, easy and rapid in their movements, indicate an interior development by inflexion; while others, more rude and less susceptible of improvement, present only a crude assemblage of small forms or agglutinated particles, each preserving the physiognomy peculiar to itself, when it is separately employed. This very ingenious view would be deficient in accuracy were it supposed that there exist polysyllabic idioms without any inflexion, or that those which are organically developed as by interior germs, admit no external increase by means of suffixes and affixes;† an increase which we have

* Whence the German *bruder*, with the same consonants.

† Even in the Sanscrit several tenses are formed by aggregation; for example, in the first future, the substantive verb 'to be' is added to the radical. In a similar manner we find in the Greek *mach-eso*, if the *s* be not the effect of inflexion, and in Latin *pot-ero* (Bopp, p. 26 and 66). These are examples of incorporation and agglutination in the gram-

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already mentioned several times under the name of agglutination or incorporation. Many things, which appear to us at present inflexions of a radical, have perhaps been in their origin affixes, of which there have barely remained one or two consonants. In languages, as in everything in nature that is organized, nothing is entirely isolated or unlike. The farther we penetrate into their internal structure, the more do contrasts and decided characters vanish. It may be said that they are like clouds, the outlines of which do not appear well defined, except when viewed at a distance.

But though we may not admit one simple and absolute principle in the classification of languages, yet it cannot be decided, that in their present state some manifest a greater tendency to inflexion, others to external aggregation. It is well known, that the languages of the Indian, Pelasgic, and German branch, belong to the first division; the American idioms, the Coptic or ancient Egyptian, and to a certain degree, the Semitic languages and the Biscayan, to the second. The little we have made known of the idiom of the Chaymas of Caripe, sufficiently proves that constant tendency towards the incorporation or aggregation of certain forms, which it is easy to separate; though from a somewhat refined sentiment of euphony some letters have been dropped and others have been added. Those affixes, by lengthening words, indicate the most varied relations of number, time, and motion.

When we reflect on the peculiar structure of the American languages, we imagine we discover the source of the opinion generally entertained from the most remote time in the Missions, that these languages have an analogy with the Hebrew and the Biscayan. At the convent of Caripe as well as at the Orinoco, in Peru as well as in Mexico, I heard this opinion expressed, particularly by monks who had some

matical system of languages which are justly cited as models of an interior developement by inflexion. In the grammatical system of the American tongues, for example in the Tamanac, *tarecschi*, 'I will carry,' is equally composed of the radical *ar* (infin. *jareri*, 'to carry') and of the verb *ecschi* (Infin. *nocschiri*, 'to be'). There hardly exists in the American languages a triple mode of aggregation, of which we cannot find a similar and analogous example in some other language that is supposed to develope itself only by inflexion.

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vague notions of the Semitic languages. Did motives supposed to be favourable to religion, give rise to this extraordinary theory? In the north of America, among the Choctaws and the Chickasaws, travellers somewhat credulous have heard the strains of the Hallelujah* of the Hebrews; as, according to the Pundits, the three sacred words of the mysteries of the Eleusis† (*konx om pax*) resound still in the Indies. I do not mean to suggest, that the nations of Latin Europe may have called whatever has a foreign physiognomy Hebrew or Biscayan, as for a long time all those monuments were called Egyptian, which were not in the Grecian or Roman style. I am rather disposed to think that the grammatical system of the American idioms has confirmed the missionaries of the sixteenth century in their ideas respecting the Asiatic origin of the nations of the New World. The tedious compilation of Father Garcia, *Tratado del Origen de los Indios*,‡ is a proof of this. The position of the possessive and personal pronouns at the end of the noun and the verb, as well as the numerous tenses of the latter, characterize the Hebrew and the other Semitic languages. Some of the missionaries were struck at finding the same peculiarities in the American tongues: they did not reflect, that the analogy of a few scattered features does not prove languages to belong to the same stock.

It appears less astonishing, that men, who are well acquainted with only two languages extremely heterogeneous, the Castilian and the Biscayan, should have found in the latter a family resemblance to the American languages. The composition of words, the facility with which the partial elements are detected, the forms of the verbs, and their different modifications, may have caused and kept up this illusion. But we repeat, an equal tendency towards aggregation or incorporation does not constitute an identity of origin. The following are examples of the relations between the American and Biscayan languages; idioms totally different in their roots.

In Chayma, *quenpotupra quoguaz*, 'I do not know,' properly, 'knowing not I am.' In Tamanac, *jarer-uac-ure*,

* L'Escarbot, Charlevoix, and even Adair (Hist. of the American Indians, 1775).

† Asiat. Res., vol. v. Ouvaroff on the Eleusinian Mysteries, 1816.

‡ Treatise on the Origin of the Indians.

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'bearing am I,—I bear'; *anarepra aichi*, 'he will not bear,' properly, 'bearing not will he'; *patcurbe*, 'good'; *patcutari*, 'to make himself good'; *Tamanacu*, 'a Tamanac'; *Tamanacutari*, 'to make himself a Tamanac;' *Ponghemo*, 'a Spaniard'; *ponghemtari*, 'to Spaniardize himself'; *teneocki*, 'I will see'; *teneicre*, 'I will see again'; *teccha*, 'I go'; *tecshare*, 'I return'; *maypur butke*, 'a little Maypure Indian'; *aicabutke*, 'a little woman;' *maypuritaje*, 'an ugly Maypure Indian'; *aicataje*, 'an ugly woman.'*

In Biscayan: *naitetutendot*, 'I love him,' properly, 'I loving have him;' *begoia*, 'the eye,' and *beguitsa*, 'to see;' *aitogana*, 'towards the father:' by adding *tu*, we form the verb *aitaganatu*, 'to go towards the father;' *ume-tasuna*, 'soft and infantile ingenuity;' *umequeria*, 'disagreeable childishness.'

I may add to these examples some descriptive compounds, which call to mind the infancy of nations, and strike us equally in the American and Biscayan languages, by a certain ingenuousness of expression. In Tamanac, the wasp (*uane-imu*), 'father (*im-de*) of honey (*uane*);'† the toes, *ptari-mucuru*, properly, 'the sons of the foot;' the fingers, *amgna-mucuru*, 'the sons of the hand;' mushrooms, *jeje-panari*, properly, 'the ears (*panari*) of a tree (*jeje*);' the veins of the hand, *amgna-mitti*, properly, 'the ramified roots;' leaves, *prutpe-jareri*, properly, 'the hair at the top of the tree;' *puireno-veju*, properly, the sun (*veju*), 'straight' or 'perpendicular;' lightning,‡ *kinemeru-uaptori*, properly, 'the fire (*uapto*) of the thunder,' or 'of the storm.' In Biscayan, *becoquia*, the forehead, 'what belongs (*co* and *quia*) to the eye (*beguia*);' *odotsa*, 'the noise (*otsa*) of the cloud (*odoia*),' or thunder; *arribicia*, an echo, properly, 'the animated stone,' from *arria*, stone, and *bicia*, life.

The Chayma and Tamanac verbs have an enormous com-

* The diminutive of 'woman' (*aica*) or of 'Maypure Indian' is formed by adding *butke*, which is the termination of *cujuputke*, 'little': *taje* answers to the *accio* of the Italians.

† It may not be unnecessary here to acquaint the reader that honey is produced by an insect of South America, belonging to, or nearly allied, to the wasp genus. This honey, however, possesses noxious qualities which are by some naturalists attributed to the plant Paulinia Australis, the juices of which are collected by the insect.

‡ I recognise in *kinemeru*, 'thunder' or 'storm,' the root *kineme* 'black.'

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plication of tenses: two Presents, four Preterites, three Futures. This multiplicity characterises the rudest American languages. Astarloa reckons, in like manner, in the grammatical system of the Biscayan, two hundred and six forms of the verb. Those languages, the principal tendency of which is inflexion, are to the common observer less interesting than those which seem formed by aggregation. In the first, the elements of which words are composed, and which are generally reduced to a few letters, are no longer recognisable: these elements, when isolated, exhibit no meaning; the whole is assimilated and mingled together. The American languages, on the contrary, are like complicated machines, the wheels of which are exposed to view. The mechaniam of their construction is visible. We seem to be present at their formation, and we should pronounce them to be of very recent origin, did we not recollect that the human mind steadily follows an impulse once given; that nations enlarge, improve, and repair the grammatical edifice of their languages, according to a plan already determined; finally, that there are countries, whose languages, institutions, and arts, have remained unchanged, we might almost say stereotyped, during the lapse of ages.

The highest degree of intellectual development has been hitherto found among the nations of the Indian and Pelasgic branch. The languages formed principally by aggregation seem themselves to oppose obstacles to the improvement of the mind. They are devoid of that rapid movement, that interior life, to which the inflexion of the root is favourable, and which impart such charms to works of imagination. Let us not, however, forget, that a people celebrated in remote antiquity, a people from whom the Greeks themselves borrowed knowledge, had perhaps a language, the construction of which recals involuntarily that of the languages of America. What a structure of little monosyllabic and dissyllabic forms is added to the verb and to the substantive, in the Coptic language! The semi-barbarous Chayma and Tamanac have tolerably short abstract words to express grandeur, envy, and lightness, *cheictivate*, *uoite*, and *uonde*; but in Coptic, the word malice,* *metrepherpetou*,

* See, on the incontestible identity of the ancient Egyptian and Coptic, and on the particular system of synthesis of the latter language, the im-

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is composed of five elements, easy to be distinguished. This compound signifies 'the quality (*met*) of a subject (*reph*), which makes (*er*) the thing which is (*pet*), evil (*ou*).' Nevertheless the Coptic language has had its literature, like the Chinese, the roots of which, far from being aggregated, scarcely approach each other without immediate contact. We must admit that nations once roused from their lethargy, and tending towards civilization, find in the most uncouth languages the secret of expressing with clearness the conceptions of the mind, and of painting the emotions of the soul. Don Juan de la Rea, a highly estimable man, who perished in the sanguinary revolutions of Quito, imitated with graceful simplicity some Idyls of Theocritus in the language of the Incas; and I have been assured, that, excepting treatises on science and philosophy, there is scarcely any work of modern literature that might not be translated into the Peruvian.

The intimate connection established between the natives of the New World and the Spaniards since the conquest, have introduced a certain number of American words into the Castilian language. Some of these words express things not unknown before the discovery of the New World, and scarcely recal to our minds at present their barbarous origin.* Almost all belong to the language of the great Antilles, formerly termed the language of Hayti, of Quizqueja, or of Itis.† I shall confine myself to citing the words *maïz*, *tabaco*, *canoa*, *batata*, *cacique*, *balsa*, *conuco*, &c. When the Spaniards, after the year 1498, began to visit the mainland, they already had words‡ to designate the vegetable productions most useful

genious reflexions of M. Silvestre de Sacy, in the *Notice des Recherches de M. Etienne Quatremère sur la Littérature de l'Egypte.*

* For example *savannah*, and *cannibal.*

† The word *Itis*, for Hayti or St. Domingo (Hispaniola), is found in the Itinerarium of Bishop Geraldini (Rome, 1631.)—"Quum Colonus *Itim* insulam cerneret."

‡ The following are Haytian words, in their real form, which have passed into the Castilian language since the end of the 15th century. Many of them are not uninteresting to descriptive botany. *Ahi* (Capsicum baccatum), *batata* (Convolvus batatas), *bihao* (Heliconia bihai), *caimito* (Chrysophyllum caimito), *cahoba* (Swietenia mahagoni), *jucca* and *casabi* (Jatropha manihot); the word *casabi* or *cassava* is employed only for the bread made with the roots of the Jatropha (the name of the plant *jucca*,

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to man, and common both to the islands and to the coasts of Cumana and Paria. Not satisfied with retaining these words borrowed from the Haytians, they helped also to spread them all over America (at a period when the language of Hayti was already a dead language), and to diffuse them among nations who were ignorant even of the existence of the West India Islands. Some words, which are in daily use in the Spanish colonies, are attributed erroneously to the Haytians. *Banana* is from the Chaconese, the *Mbaja* language; *arepa* (bread of manioc, or of the Jatropha manihot) and *guayuco* (an apron, *perizoma*) are Caribbee: *curiara* (a very long boat) is Tamanac: *chinchorro* (a hammock), and *tutuma* (the fruit of the Crescentia cujete, or a vessel to contain a liquid), are Chayma words.

I have dwelt thus long on considerations respecting the American tongues, because I am desirous of directing attention to the deep interest attached to this kind of research. This interest is analogous to that inspired by the monuments of semi-barbarous nations, which are examined

was also heard by Americo Vespucci on the coast of Paria); *age* or *ajes* (Dioscorea alata), *copei* (Clusia alba), *guayacan* (Guaiacum officinale), *guajaba* (Psidium pyriferum), *guanavano* (Anona muricata), *mani* (Arachis hypogæa), *guama* (Inga), *henequen* (was supposed from the erroneous accounts of the first travellers to be an herb with which the Haytians used to cut metals; it means now every kind of strong thread), *hicaco* (Chrysobalanus icaco), *maghei* (Agave Americana), *mahiz* or *matz* (Zea, maize), *mamei* (Mammea Americana), *mangle* (Rhizophora), *pitahaja* (Cactus pitahaja), *ceiba* (Bombax), *tuna* (Cactus tuna), *hicotea* (a tortoise), *iguana* (Lacerta iguana), *manati* (Trichecus manati), *nigua* (Pulex penetrans), *hamaca* (a hammock), *balsa* (a raft; however *balsa* is an old Castilian word signifying a pool of water), *barbacoa* (a small bed of light wood, or reeds), *canei* or *buhio* (a hut), *canoa* (a canoe), *cocujo* (Elater noctilucus, the fire-fly), *chicha* (fermented liquor), *macana* (a large stick or club, made with the petioles of a palm-tree), *tabaco* (not the herb, but the pipe through which it is smoked), *cacique* (a chief). Other American words, now as much in use among the Creoles, as the Arabic words naturalized in the Spanish, do not belong to the Haytian tongue; for example, *caiman, piragua, papaja* (Carica), *aguacate* (Persea), *tarabita, paramo*. Abbé Gili thinks with some probability, that they are derived from the tongue of some people who inhabited the temperate climate between Coro, the mountains of Merida, and the table-land of Bogotá. (Saggio, vol. iii., p. 228.) How many Celtic and German words would not Julius Cæsar and Tacitus have handed down to us, had the productions of the northern countries visited by the Romans differed as much from the Italian and Roman, as those of equinoctial America!

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not because they deserve to be ranked among works of art, but because the study of them throws light on the history of our species, and the progressive development of our faculties.

It now remains for me to speak of the other Indian nations inhabiting the provinces of Cumana and Barcelona. These I shall only succinctly enumerate.

I. The *Pariagotos* or *Parias*. It is thought that the terminations in *goto*, as Pariagoto, Purugoto, Avarigoto, Acherigoto, Cumanagoto, Arinagoto, Kirikirisgoto,* imply a Caribbean origin.† All these tribes, excepting the Purugotos of the Rio Caura, formerly occupied the country which has been so long under the dominion of the Caribbees; namely, the coasts of Berbice and of Essequibo, the peninsula of Paria, the plains of Piritu and Parima. By this last name the little-known country, between the sources of the Cujuni, the Caroni, and the Mao, is designated in the Missions. The Paria Indians are mingled in part with the Chaymas of Cumana; others have been settled by the Capuchins of Aragon in the Missions of Caroni; for instance, at Cupapuy and Alta-Gracia, where they still speak their own language, apparently a dialect between the Tamanac and the Caribbee. But it may be asked, is the name Parias or Pariagotos, a name merely geographical? Did the Spaniards, who frequented these coasts from their first establishment in the island of Cubagua and in Macarapana, give the name of the promontory of Paria‡ to the tribe by

* The *Kirikirisgotos* (or *Kirikiripas*) are of Dutch Guiana. It is very remarkable, that among the small Brazilian tribes who do not speak the language of the Tupis, the *Kiriris*, notwithstanding the enormous distance of 650 leagues, have several Tamanac words.

† In the Tamanac tongue, which is of the same branch as the Caribbean, we find also the termination *goto*, as in *anekiamgoto* 'an animal.' Often an analogy in the termination of names, far from showing an identity of race, only indicates that the names of the nations are borrowed from one language.

‡ Paria, Uraparia, even Huriaparia and Payra, are the ancient names of the country, written as the first navigators thought they heard them pronounced. It appears to me by no means probable, that the promontory of Paria should derive its name from that of a cacique *Uriaperi*, celebrated for the manner in which he resisted Diego Ordaz in 1530, thirty-two years after Columbus had heard the name of *Paria* from the mouths of the natives themselves. The Orinoco at its mouth had also the name of Uriapari, Yuyapari, or Iyupari. In all these denominations of a

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which it was inhabited? This we will not positively affirm; for the Caribbees themselves give the name of Caribana to a country which they occupied, and which extended from the Rio Sinu to the gulf of Darien. This is a striking example of identity of name between an American nation and the territory it possessed. We may conceive, that in a state of society, where residence is not long fixed, such instances must be very rare.

II. The *Guaraons* or *Gu-ara-una*, almost all free and independent, are dispersed in the Delta of the Orinoco, with the variously ramified channels of which they alone are well acquainted. The Caribbees call the Guaraons *U-ara-u*. They owe their independence to the nature of their country; for the missionaries, in spite of their zeal, have not been tempted to follow them to the tree-tops. The Guaraons, in order to raise their abodes above the surface of the waters at the period of the great inundations, support them on the hewn trunks of the mangrove-tree and of the Mauritia palm-tree.* They make bread of the medullary flour of this palm-tree, which is the sago of America. The flour bears the name of *yuruma:* I have eaten it at the town of St. Thomas, in Guiana, and it was very agreeable to the taste, resembling rather the cassava-bread

great river, of a shore, and of a rainy country, I think I recognise the radical *par*, signifying water, not only in the languages of these countries, but also in those of nations very distant from one another on the eastern and western coasts of America. The sea, or great water, is in the Caribbean, Maypure, and Brazilian languages, *parana:* in the Tamanac, *parava*. In Upper Guiana also the Orinoco is called *Parava*. In the Peruvian, or Quichua, I find 'rain,' *para;* 'to rain,' *parani*. Besides, there is a lake in Peru that has been very anciently called Paria. (Garcia, Origen de los Indios, p. 292.) I have entered into these minute details concerning the word Paria, because it has recently been supposed that some connection might be traced between this word and the country of the Hindoo caste called the Parias.

* Their manners have been the same from time immemorial. Cardinal Bembo described them at the beginning of the 16th century, "quibusdam in locis propter paludes incolæ domus in arboribus ædificant." (Hist. Venet., 1551.) Sir Walter Raleigh, in 1595, speaks of the Guaraons under the names of *Araottes*, *Trivitivas*, and *Warawites*. These were perhaps the names of some tribes, into which the great Guaraonese nation was divided. (Barrère, Essai sur l'Hist. Naturelle de la France Equinoctiale.)

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than the sago of India.* The Indians assured me that the trunks of the Mauritia, the *tree of life* so much vaunted by father Gumilla, do not yield meal in any abundance, unless the palm-tree is cut down just before the flowers appear. Thus too the *maguey*,† cultivated in New Spain, furnishes a saccharine liquor, the wine (pulque) of the Mexicans, only at the period when the plant shoots forth its long stem. By interrupting the blossoming, nature is obliged to carry elsewhere the saccharine or amylaceous matter, which would accumulate in the flowers of the maguey and in the fruit of the Mauritia. Some families of Guaraons, associated with the Chaymas, live far from their native land, in the Missions of the plains or llanos of Cumana; for instance, at Santa Rosa de Ocopi. Five or six hundred of them voluntarily quitted their marshes, a few years ago, and formed, on the northern and southern banks of the Orinoco, twenty-five leagues distant from Cape Barima, two considerable villages, under the names of Zacupana and Imataca. When I made my journey in Caripe, these Indians were still without missionaries, and lived in complete independence. Their excellent qualities as boatmen, their perfect knowledge of the mouths of the Orinoco, and of the labyrinth of branches communicating with each other, give the Guaraons a certain political importance. They favour that clandestine commerce of which the island of Trinidad is the centre. The Guaraons run with extreme address on muddy lands, where the European, the Negro, or other Indians except themselves, would not dare to walk; and it is, therefore, commonly believed, that they are of lighter weight than the rest of the natives. This is also the opinion that is held in Asia of the Burat Tartars. The few Guaraons whom I saw were of middle size, squat, and very muscular. The lightness with which they walk in places newly dried, without sinking in, when even they have no planks tied to their feet, seemed to me the effect of long habit. Though I sailed a considerable time on the Orinoco, I never went so low as its mouth. Future tra-

* M. Kunth has combined together three genera of the palms, Calamus, Sigus, and Mauritia, in a new section, the Calameæ.

† Agave Americana, the aloe of our gardens.

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vellers, who may visit those marshy regions, will rectify what I have advanced.

III. The *Guaiqueries* or *Guaikeri*, are the most able and most intrepid fishermen of these countries. These people alone are well acquainted with the bank abounding with fish, which surrounds the islands of Coche, Margareta, Sola, and Testigos; a bank of more than four hundred square leagues, extending east and west from Maniquarez to the Boca del Draco. The Guaiqueries inhabit the island of Margareta, the peninsula of Araya, and that suburb of Cumana which bears their name. Their language is believed to be a dialect of that of the Guaraons. This would connect them with the great family of the Caribbee nations; and the missionary Gili is of opinion that the language of the Guaiqueries is one of the numerous branches of the Caribbean tongue.* These affinities are interesting, because they lead us to perceive an ancient connection between nations dispersed over a vast extent of country, from the mouth of the Rio Caura and the sources of the Erevato, in Parima, to French Guiana, and the coasts of Paria.†

IV. The *Quaquas*, whom the Tamanacs call *Mapoje*, are a tribe formerly very warlike and allied to the Caribbees. It is a curious phenomenon to find the Quaquas mingled with the Chaymas in the Missions of Cumana, for their language, as well as the Atura, of the cataracts of the Orinoco, is a

* If the name of the port *Pam-patar*, in the island of Margareta, be Guaiquerean, as we have no reason to doubt, it exhibits a feature of analogy with the Cumanagoto tongue, which approaches the Caribbean and Tamanac. In Terra Firma, in the Piritu Missions, we find the village of *Cayguapatar*, which signifies *house of Caygua*.

† Are the *Guaiqueries*, or *O-aikeries*, now settled on the borders of the Erevato, and formerly between the Rio Caura and the Cuchivero, near the little town of Alta Gracia, of a different origin from the Guaikeries of Cumana? I know also, in the interior of the country, in the Missions of the Piritus, near the village of San Juan Evangelista del Guarive, a ravine very anciently called *Guayquiricuar*. These resemblances seem to prove migrations from the south-west towards the coast. The termination *cuar*, found so often in Cumanagoto and Caribbean names, means a *ravine*, as in *Guaymacuar* (ravine of lizards), *Pirichucuar* (a ravine overshaded by pirichu or piritu palm-trees), *Chiguatacuar* (a ravine of land-shells). Raleigh describes the Guaiqueries under the name of Ouikeries. He calls the Chaymas, Saimas, changing (according to the Caribbean pronunciation) the *ch* into *s*.

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dialect of the Salive tongue; and their original abode was on the banks of the Assiveru, which the Spaniards call Cuchivero. They have extended their migrations one hundred leagues to the north-east. I have often heard them mentioned on the Orinoco, above the mouth of the Meta; and, what is very remarkable, it is asserted * that missionary Jesuits have found Quaquas as far distant as the Cordilleras of Popayan. Raleigh enumerates, among the natives of the island of Trinidad, the Salives, a people remarkable for their mild manners; they came from the Orinoco, and settled south of the Quaquas. Perhaps these two nations, which speak almost the same language, travelled together towards the coasts.

V. The *Cumanagotos*, or, according to the pronunciation of the Indians, *Cumanacoto*, are now settled westward of Cumana, in the Missions of Piritu, where they live by cultivating the ground. They number more than twenty-six thousand. Their language, like that of the Palencas, or Palenques, and Guarivas, is between the Tamanac and the Caribbee, but nearer to the former. These are indeed idioms of the same family; but if we are to consider them as simple dialects, the Latin must be also called a dialect of the Greek, and the Swedish a dialect of the German. In considering the affinity of languages one with another, it must not be forgotten that these affinities may be very differently graduated; and that it would be a source of confusion not to distinguish between simple dialects and languages of the same family. The Cumanagotos, the Tamanacs, the Chaymas, the Guaraons, and the Caribbees, do not understand each other, in spite of the frequent analogy of words and of grammatical structure exhibited in their respective idioms. The Cumanagotos inhabited, at the beginning of the sixteenth century, the mountains of the Brigantine and of Parabolata. I am unable to determine whether the Piritus, Cocheymas, Chacopatas, Tomuzas, and Topocuares, now confounded in the same villages with the Cumanagotos, and speaking their language, were originally tribes of the same nation. The Piritus

* Vater, tom. iii. pt. ii., p. 364. The name of *Quaqua* is found on the coast of Guinea. The Europeans apply it to a horde of Negroes to the east of Cape Lahou.

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take their name from the ravine *Pirichucuar*, where the small thorny palm-tree,* called *piritu*, grows in abundance; the wood of this tree, which is excessively hard, and little combustible, serves to make pipes. On this spot the village of La Concepcion de Piritu was founded in 1556; it is the chief settlement of the Cumanagoto Missions, known by the name of the *Misiones de Piritu*.

VI. The *Caribbees (Carives)*. This name, which was given them by the first navigators, is retained throughout all Spanish America. The French and the Germans have transformed it, I know not why, into Caraïbes. The people call themselves *Carina*, *Calina*, and *Callinago*. I visited some Caribbean Missions in the *Llanos*,† on returning from my journey to the Orinoco; and I shall merely mention that the *Galibes* (*Caribi* of Cayenne), the Tuapocas, and the Cunaguaras, who originally inhabited the plains between the mountains of Caripe (Caribe) and the village of Maturin, the *Jaoi* of the island of Trinidad and of the province of Cumana, and perhaps also the Guarivas, allies of the Palencas, are all tribes of the great Caribbee nation.

With respect to the other nations whose affinities of language with the Tamanac and Caribbee have been mentioned, they are not necessarily to be considered as of the same race. In Asia, the nations of Mongol origin differ totally in their physical organisation from those of Tartar origin. Such has been, however, the intermixture of these nations, that, according to the able researches of Klaproth, the Tartar languages (branches of the ancient Oigour) are spoken at present by hordes incontestably of Mongol race. Neither the analogy nor the diversity of language suffice to solve the great problem of the filiation of nations; they merely serve to point out probabilities. The Caribbees, properly speaking, those who inhabit the Missions of the Cari, in the llanos of Cumana, the banks

* Caudice gracili aculeato, foliis pinnatis. Possibly of the genus Aiphanes of Willdenouw.

† I shall in future use the word *Llanos* (*loca plana*, suppressing the *p*), without adding the equivalent words pampas, savannahs, meadows, steppes, or plains. The country between the mountains of the coast and the left bank of the Orinoco, constitutes the llanos of Cumana, Barcelona, and Caracas.

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of the Caura, and the plains to the north-east of the sources of the Orinoco, are distinguished by their almost gigantic size from all the other nations I have seen in the new continent. Must it on this account be admitted, that the Caribbees are an entirely distinct race? and that the Guaraons and the Tamanacs, whose languages have an affinity with the Caribbee, have no bond of relationship with them? I think not. Among the nations of the same family, one branch may acquire an extraordinary development of organization. The mountaineers of the Tyrol and Salzburgh are taller than the other Germanic races; the Samoiedes of the Altai are not so little and squat as those of the sea-coast. In like manner it would be difficult to deny that the Galibis are really Caribbees; and yet, notwithstanding the identity of languages, how striking is the difference in their stature and physical constitution!

Before Cortez entered the capital of Montezuma in 1521, the attention of Europe was fixed on the regions we have just traversed. In depicting the manners of the inhabitants of Paria and Cumana, it was thought that the manners of all the inhabitants of the new continent were described. This remark cannot escape those who read the historians of the Conquest, especially the letters of Peter Martyr of Anghiera, written at the court of Ferdinand the Catholic. These letters are full of ingenious observations upon Christopher Columbus, Leo X, and Luther, and are stamped by noble enthusiasm for the great discoveries of an age so rich in extraordinary events. Without entering into any detail on the manners of the nations which have been so long confounded one with another, under the vague denomination of Cumanians (*Cumaneses*), it appears to me important to clear up a fact which I have often heard discussed in Spanish America.

The Pariagotos of the present time are of a brown red colour, as are the Caribbees, the Chaymas, and almost all the nations of the New World. Why do the historians of the sixteenth century affirm that the first navigators saw white men with fair hair at the promontory of Paria? Were they of the same race as those Indians of a less tawny hue, whom M. Bonpland and myself saw at Esmeralda, near the sources of the Orinoco? But these Indians had hair as

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black as the Otomacs and other tribes, whose complexion is the darkest. Were they albinoes, such as have been found heretofore in the isthmus of Panama? But examples of that degeneration are very rare in the copper-coloured race; and Anghiera, as well as Gomara, speaks of the inhabitants of Paria in general, and not of a few individuals. Both describe them as if they were people of Germanic origin;* they call them 'Whites with light hair;' they even add, that they wore garments like those of the Turks.† Gomara and Anghiera wrote from such oral information as they had been able to collect.

These marvels disappear, if we examine the recital which Ferdinand Columbus drew up from his father's papers. There we find simply, that "the admiral was surprised to

* "Æthiopes nigri, crispi lanati; Pariæ incolæ *albi*, capillis oblongis protensis flavis."—Pet. Martyr, *Oceân.*, dec. 1, lib. vi., (ed. 1574). "Utriusque sexus indigenæ albi veluti nostrates, præter eos qui sub sole versantur." (The natives of both sexes are as white as our people [Spaniards], except those who are exposed to the sun.)—Ibid. Gomara, speaking of the natives seen by Columbus at the mouth of the river of Cumana, says: "Las donzellas eran amorosas, desnudas y blancas (las de la casa); los Indios que van al campo estan negros del sol." (The young women are engaging in their manners: they wear no clothing, and those who live in the houses *are white*. The Indians who are much in the open country are black, from the effect of the sun.)—Hist. de los Indios, cap. 74. "Los Indios de Paria son *blancos* y rubios."—(The Indians of Paria are *white* and red.) Garcia, Origen de los Indios, 1729, lib. iv. cap. 9.

† "They wear round their head a striped cotton handkerchief."—Ferd. Columb., cap. 71. (Churchill, vol. ii.) Was this kind of head-dress taken for a turban? (Garcia, Origen de los Ind., p. 303). I am surprised that people of these regions should have worn a head-dress; but, what is more curious still, Pinzon, in a voyage which he made alone to the coast of Paria, the particulars of which have been transmitted to us by Peter Martyr of Anghiera, professes to have seen natives who were clothed: "Incolas omnes genu tenus mares, fœminas surarum tenus, gossampinis vestibus amictos simplicibus repererunt; sed viros more Turcorum insuto minutim gossypio ad belli usum duplicibus." (The natives were clothed in thin cotton garments; the men's reaching to the knee, and the women's to the calf of the leg. Their war-dress was thicker, and closely stitched with cotton after the Turkish manner.)—Pet. Martyr, dec. ii., lib. vii. Who were these people described as being comparatively civilized, and clothed with tunics (like those who lived on the summit of the Andes), and seen on a coast, where before and since the time of Pinzon, only naked men have ever been seen?

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see the inhabitants of Paria, and those of the island of Trinidad, better made, more civilized (de buena conversacion), and whiter than the natives whom he had previously seen."* This certainly did not mean that the Pariagotos are white. The lighter colour of the skin of the natives, and the great coolness of the mornings on the coast of Paria, seemed to confirm the fantastic hypothesis which that great man had framed, respecting the irregularity of the curvature of the earth, and the height of the plains in this region, which he regarded as the effect of an extraordinary swelling of the globe in the direction of the parallels of latitude. Amerigo Vespucci (in his pretended *first* voyage, apparently written from the narratives of other navigators) compares the natives to the Tartar nations,† not in regard to their colour, but on account of the breadth of their faces, and the general expression of their physiognomy.

But if it be certain, that at the end of the fifteenth century there were on the coast of Cumana a few men with white skins, as there are in our days, it must not thence be concluded, that the natives of the New World exhibit everywhere a similar organization of the dermoidal system. It is not less inaccurate to say, that they are all copper-coloured, than to affirm that they would not have a tawny hue, if they were not exposed to the heat of the sun, or tanned by the action of the air. The natives may be divided into two very unequal portions with respect to numbers; to the first belong the Esquimaux of Greenland, of Labrador, and the northern coast of Hudson's Bay, the inhabitants of Behring's Straits, of the peninsula

* Churchill's Collection, vol. ii. Herrera, pp. 80, 83, 84. Munoz, Hist. del Nuevo Mundo, vol. i., "El color era baxo como es regular en los Indios, pero mas claro que en las islas reconocidas." (Their colour was dark, as is usual among the Indians; but lighter than that of the people of the islands previously known.) The missionaries are accustomed to call those Indians who are less black, less tawny, *whitish*, and even *almost white*.—Gumilla, Hist. de l'Orenoque, vol. i., chap. v., § 2. Such incorrect expressions may mislead those who are not accustomed to the exaggerations in which travellers often indulge.

† Vultu non multum speciosi sunt, quoniam latas facies Tartariis adsimilatas habent. (Their countenances are not handsome, their cheek-bones being broad like those of the Tartars.)—Americi Vespatii Navigatio Prima, in Gryn's Orbis Novus, 1555.

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of Alaska, and of Prince William's Sound. The eastern and western branches* of this polar race, the Esquimaux and the Tschougases, though at the vast distance of eight hundred leagues apart, are united by the most intimate analogy of languages. This analogy extends even to the inhabitants of the north-east of Asia; for the idiom of the Tschouktsches† at the mouth of the Anadir, has the same roots as the language of the Esquimaux who inhabit the coast of America opposite to Europe. The Tschouktsches are the Esquimaux of Asia. Like the Malays, that hyperborean race reside only on the sea-coasts. They are almost all smaller in stature than the other Americans, and are quick, lively, and talkative. Their hair is almost straight, and black; but their skin (and this is very characteristic of the race, which I shall designate under the name of Tschougaz-Esquimaux) is originally whitish. It is certain that the children of the Greenlanders are born white; some retain that whiteness; and often in the brownest (the most tanned) the redness of the blood is seen to appear on their cheeks.‡

The second portion of the natives of America includes all those nations which are not Tschougaz-Esquimaux, beginning from Cook's River to the Straits of Magellan, from the Ugaljachmouzes and the Kinaese of Mount St. Elias, to the Puelches and Tehuelhets of the southern hemisphere. The men who belong to this second branch, are taller, stronger, more warlike, and more taciturn than the others. They present also very remarkable differences in the colour of their skin. In Mexico, Peru, New Grenada, Quito, on the banks of the Orinoco and of the river Amazon, in every part of South America which I have explored, in the plains as well as on the coldest table-lands, the Indian children of two or three months old have the same bronze tint as

* Vater, in Mithridates, vol. iii. Egede, Krantz, Hearne, Mackenzie, Portlock, Chwostoff, Davidoff, Resanoff, Merk, and Billing, have described the great family of these Tschougaz-Esquimaux.

† I mean here only the Tschouktsches who have fixed dwelling-places, for the wandering Tschouktsches approach very near the Koriaks.

‡ Krantz, Hist. of Greenland, 1667, tom. i. Greenland does not seem to have been inhabited in the eleventh century; at least the Esquimaux appeared only in the fourteenth, coming from the west.

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is observed in adults. The idea that the natives may be whites tanned by the air and the sun, could never have occurred to a Spanish inhabitant of Quito, or of the banks of the Orinoco. In the north-east of America, on the contrary, we meet with tribes among whom the children are white, and at the age of virility they acquire the bronze colour of the natives of Mexico and Peru. Michikinakoua, chief of the Miamis, had his arms, and those parts of his body not exposed to the sun, almost white. This difference of hue between the parts covered and not covered is never observed among the natives of Peru and Mexico, even in families who live much at their ease, and remain almost constantly within doors. To the west of the Miamis, on the coast opposite to Asia, among the Kolouches and Tchinkitans* of Norfolk Sound, grown-up girls, when they have washed their skin, display the white hue of Europeans. This whiteness is found also, according to some accounts, among the mountaineers of Chile.†

These facts are very remarkable, and contrary to the opinion so generally spread, of the extreme conformity of organization among the natives of America. If we divide them into Esquimaux and non-Esquimaux, we readily admit that this classification is not more philosophical than that of the ancients, who saw in the whole of the habitable world only Celts and Scythians, Greeks, and Barbarians. When, however, our purpose is to group numerous nations, we gain something by proceeding in the mode of exclusion. All we have sought to establish here is, that, in separating the whole race of Tschougaz-Esquimaux, there remain still, among the coppery-brown Americans, other races, the children of which are born white, without our being able to prove, by going back as far as the history of the Conquest, that they have been mingled with European blood. This fact deserves to be cleared up by tra-

* Between 54° and 58° of latitude. These white nations have been visited successively by Portlock, Marchand, Baranoff, and Davidoff. The Tchinkitans, or Schinkit, are the inhabitants of the island of Sitka. Vater, Mithridates, vol. iii., p. 2. Marchand, Voyages, vol. ii.

† Molina, Saggio sull' Istoria Nat. del Chile, edit. 2, p. 293. May we believe the existence of those blue eyes of the Boroas of Chile and Guayanas of Uruguay, represented to us as nations of the race of Odin? Azara, Voyage, tom. ii.

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vellers who may possess a knowledge of physiology, and may have opportunities of examining the brown children of the Mexicans at the age of two years, as well as the white children of the Miamis, and those hordes* on the Orinoco, who, living in the most sultry regions, retain during their whole life, and in the fulness of their strength, the whitish skin of the Mestizoes.

In man, the deviations from the common type of the whole race are apparent in the stature, the physiognomy, or the form of the body, rather than on the colour of the skin.† It is not so with animals, where varieties are found more in colour than in form. The hair of the mammiferous class of animals, the feathers of birds, and even the scales of fishes, change their hue, according to the lengthened influence of light and darkness, and the intensity of heat and cold. In man, the colouring matter seems to be deposited in the epidermis by the roots or the bulbs of the hair:‡ and all sound observations prove, that the skin varies in colour from the action of external stimuli on individuals, and not hereditarily in the whole race. The Esquimaux of Greenland and the Laplanders are tanned by the influence of the air; but their children are born white. We will not decide on the changes which nature may have produced in a space of time exceeding all historical tradition. Reason stops short in these matters, when no longer under the guidance of experience and analogy.

All white-skinned nations begin their cosmogony by white men; they allege that the negroes and all tawny people have been blackened or embrowned by the excessive heat of the sun. This theory, adopted by the Greeks,§ though it did not pass without contradiction,‖ has been propagated

* These whitish tribes are the Guaycas, the Ojos, and the Maquiritares.

† The circumpolar nations of the two continents are small and squat, though of races entirely different.

‡ Adverting to the interesting researches of M. Gaultier, on the organisation of the human skin, John Hunter observes, that in several animals the colorating of the hair is independent of that of the skin.

§ Strabo, liv. xv.

‖ Onesicritus, apud Strabonem, lib. xv. Alexander's expedition appears to have contributed greatly to fix the attention of the Greeks on the great question of the influence of climates. They had learned from

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even to our own times. Buffon has repeated in prose what Theodectes had expressed in verse two thousand years before: "that nations wear the livery of the climate in which they live." If history had been written by black nations, they would have maintained what even Europeans have recently advanced,* that man was originally black, or of a very tawny colour; and that mankind have become white in some races, from the effect of civilization and progressive debilitation, as animals, in a state of domestication, pass from dark to lighter colours. In plants and in animals, accidental varieties, formed under our own eyes, have become fixed, and have been propagated;† but nothing proves, that in the present state of human organization, the different races of black, yellow, copper-coloured, and white men, when they remain unmixed, deviate considerably from their primitive type, by the influence of climate, of food, and other external agents.

These opinions are founded on the authority of Ulloa.‡ That learned writer saw the Indians of Chile, of the Andes of Peru, of the burning coasts of Panama, and those of Louisiana, situated in the northern temperate zone. He had

the accounts of travellers, that in Hindostan the nations of the south were of darker colour than those of the north, near the mountains: and they supposed that they were both of the same race.

* See the work of Mr. Prichard, abounding with curious research. "Researches into the Physical History of Man, 1813," p. 239.

† For example, the sheep with very short legs, called *ancon sheep* in Connecticut, and examined by Sir Everard Home. This variety dates only from the year 1791.

‡ "The Indians [Americans] are of a copper-colour, which by the action of the sun and the air grows darker. I must remark, that neither heat nor cold produces any sensible change in the colour, so that the Indians of the Cordilleras of Peru are easily confounded with those of the hottest plains; and those who live under the Line cannot be distinguished, by their colour, from those who inhabit the fortieth degree of north and south latitude."—Noticias Americanas. No ancient author has so clearly stated the two forms of reasoning, by which we still explain in our days the differences of colour and features among neighbouring nations, as Tacitus. He makes a just distinction between the influence of climate, and hereditary dispositions; and, like a philosopher persuaded of our profound ignorance of the origin of things, he leaves the question undecided. "Habitus corporum varii; atque ex eo argumenta, seu durante originis vi, seu procurrentibus in diversa terris, positio cœli corporibus habitum dedit."—Agricola, cap. ii.

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the good fortune to live at a period when theories were less numerous; and, like me, he was struck by seeing the natives equally bronzed under the Line, in the cold climate of the Cordilleras, and in the plains. Where differences of colour are observed, they depend on the race. We shall soon find on the burning banks of the Orinoco Indians with a whitish skin. *Durans originis vis est.*

Chapter X.

Second abode at Cumana.—Earthquakes.—Extraordinary Meteors.

We remained a month longer at Cumana, employing ourselves in the necessary preparations for our proposed visit to the Orinoco and the Rio Negro. We had to choose such instruments as could be most easily transported in narrow boats; and to engage guides for an inland journey of ten months, across a country without communication with the coasts. The astronomical determination of places being the most important object of this undertaking, I felt desirous not to miss the observation of an eclipse of the sun, which was to be visible at the end of October: and in consequence I preferred remaining till that period at Cumana, where the sky is generally clear and serene. It was now too late to reach the banks of the Orinoco before October; and the high valleys of Caracas promised less favourable opportunities, on account of the vapours which accumulate round the neighbouring mountains.

I was, however, near being compelled by a deplorable occurrence, to renounce, or at least to delay for a long time, my journey to the Orinoco. On the 27th of October, the day before the eclipse, we went as usual, to take the air on the shore of the gulf, and to observe the instant of high water, which in those parts is only twelve or thirteen inches. It was eight in the evening, and the breeze was not yet stirring. The sky was cloudy; and during a dead calm it was excessively hot. We crossed the beach which separates the suburb of the Guayqueria Indians from the embarcadero. I heard some one walking behind us, and on turning, I saw a tall man of the colour of the Zambos, naked to the waist.

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He held almost over my head a *macana*, which is a great stick of palm-tree wood, enlarged to the end like a club. I avoided the stroke by leaping towards the left; but M. Bonpland, who walked on my right, was less fortunate. He did not see the Zambo so soon as I did, and received a stroke above the temple, which levelled him with the ground. We were alone, without arms, half a league from any habitation, on a vast plain bounded by the sea. The Zambo, instead of attacking me, moved off slowly to pick up M. Bonpland's hat, which, having somewhat deadened the violence of the blow, had fallen off and lay at some distance. Alarmed at seeing my companion on the ground, and for some moments senseless, I thought of him only. I helped him to raise himself, and pain and anger doubled his strength. We ran toward the Zambo, who, either from cowardice, common enough in people of this caste, or because he perceived at a distance some men on the beach, did not wait for us, but ran off in the direction of the Tunal, a little thicket of cactus and arborescent avicennia. He chanced to fall in running; and M. Bonpland, who reached him first, seized him round the body. The Zambo drew a long knife; and in this unequal struggle we should infallibly have been wounded, if some Biscayan merchants, who were taking the air on the beach, had not come to our assistance. The Zambo seeing himself surrounded, thought no longer of defence. He again ran away, and we pursued him through the thorny cactuses. At length, tired out, he took shelter in a cow-house, whence he suffered himself to be quietly led to prison.

M. Bonpland was seized with fever during the night; but being endowed with great energy and fortitude, and possessing that cheerful disposition which is one of the most precious gifts of nature, he continued his labours the next day. The stroke of the macana had extended to the top of his head, and he felt its effect for the space of two or three months during the stay we made at Caracas. When stooping to collect plants, he was sometimes seized with giddiness, which led us to fear that an internal abscess was forming. Happily these apprehensions were unfounded, and the symptoms, at first alarming, gradually disappeared. The inhabitants of Cumana showed us the kindest interest. It was ascertained that the Zambo was a native of one of the

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Indian villages which surround the great lake of Maracaibo. He had served on board a privateer belonging to the island of St. Domingo, and in consequence of a quarrel with the captain he had been left on the coast of Cumana, when the ship quitted the port. Having seen the signal which we had fixed up for the purpose of observing the height of the tides, he had watched the moment when he could attack us on the beach. But why, after having knocked one of us down, was he satisfied with simply stealing a hat? In an examination he underwent, his answers were so confused and stupid, that it was impossible to clear up our doubts. Sometimes he maintained that his intention was not to rob us; but that, irritated by the bad treatment he had suffered on board the privateer of St. Domingo, he could not resist the desire of attacking us, when he heard us speak French. Justice is so tardy in this country, that prisoners, of whom the jail is full, may remain seven or eight years without being brought to trial; we learnt, therefore, with some satisfaction, that a few days after our departure from Cumana, the Zambo had succeeded in breaking out of the castle of San Antonio.

On the day after this occurrence, the 28th of October, I was, at five in the morning, on the terrace of our house, making preparations for the observation of the eclipse. The weather was fine and serene. The crescent of Venus, and the constellation of the Ship, so splendid from the disposition of its immense nebulæ, were lost in the rays of the rising sun. I had a complete observation of the progress and the close of the eclipse. I determined the distance of the horns, or the differences of altitude and azimuth, by the passage over the threads of the quadrant. The eclipse terminated at $2^h\ 14'\ 23{\cdot}4''$ mean time, at Cumana.

During a few days which preceded and followed the eclipse of the sun, very remarkable atmospherical phenomena were observable. It was what is called in those countries the season of winter; that is, of clouds and small electrical showers. From the 10th of October to the 3rd of November, at nightfall, a reddish vapour arose in the horizon, and covered, in a few minutes, with a veil more or less thick, the azure vault of the sky. Saussure's hygrometer, far from indicating greater humidity, often went back from

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90° to 83°. The heat of the day was from 28° to 32°, which for this part of the torrid zone is very considerable. Sometimes, in the midst of the night, the vapours disappeared in an instant; and at the moment when I had arranged my instruments, clouds of brilliant whiteness collected at the zenith, and extended towards the horizon. On the 18th of October these clouds were so remarkably transparent, that they did not hide stars even of the fourth magnitude. I could distinguish so perfectly the spots of the moon, that it might have been supposed its disk was before the clouds. The latter were at a prodigious height, disposed in bands, and at equal distances, as from the effect of electric repulsions:—these small masses of vapour, similar to those I saw above my head on the ridge of the highest Andes, are, in several languages, designated by the name of *sheep*. When the reddish vapour spread lightly over the sky, the great stars, which in general, at Cumana, scarcely scintillate below 20° or 25°, did not retain even at the zenith, their steady and planetary light. They scintillated at all altitudes, as after a heavy storm of rain.* It was curious that the vapour did not affect the hygrometer at the surface of the earth. I remained a part of the night seated in a balcony, from which I had a view of a great part of the horizon. In every climate I feel a peculiar interest in fixing my eyes, when the sky is serene, on some great constellation, and seeing groups of vesicular vapours appear and augment, as around a central nucleus, then, disappearing, form themselves anew.

After the 28th of October, the reddish mist became thicker than it had previously been. The heat of the nights

* I have not observed any direct relation between the scintillation of the stars and the dryness of that part of the atmosphere open to our researches. I have often seen at Cumana a great scintillation of the stars of Orion and Sagittarius, when Saussure's hygrometer was at 85°. At other times, these same stars, considerably elevated above the horizon, emitted a steady and planetary light, the hygrometer being at 90° or 93°. Probably it is not the quantity of vapour, but the manner in which it is diffused, and more or less dissolved in the air, which determines the scintillation. The latter is invariably attended with a coloration of light. It is remarkable enough, that, in northern countries, at a time when the atmosphere appears perfectly dry, the scintillation is most decided in very cold weather.

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seemed stifling, though the thermometer rose only to 26°. The breeze, which generally refreshed the air from eight or nine o'clock in the evening, was no longer felt. The atmosphere was burning hot, and the parched and dusty ground was cracked on every side. On the 4th of November, about two in the afternoon, large clouds of peculiar blackness enveloped the high mountains of the Brigantine and the Tataraqual. They extended by degrees as far as the zenith. About four in the afternoon thunder was heard over our heads, at an immense height, not regularly rolling, but with a hollow and often interrupted sound. At the moment of the strongest electric explosion, at 4^h 12′, there were two shocks of earthquake, which followed each other at the interval of fifteen seconds. The people ran into the streets, uttering loud cries. M. Bonpland, who was leaning over a table examining plants, was almost thrown on the floor. I felt the shock very strongly, though I was lying in a hammock. Its direction was from north to south, which is rare at Cumana. Slaves, who were drawing water from a well more than eighteen or twenty feet deep, near the river Manzanares, heard a noise like the explosion of a strong charge of gunpowder. The noise seemed to come from the bottom of the well; a very curious phenomenon, though very common in most of the countries of America which are exposed to earthquakes.

A few minutes before the first shock there was a very violent blast of wind, followed by electrical rain falling in great drops. I immediately tried the atmospherical electricity by the electrometer of Volta. The small balls separated four lines; the electricity often changed from positive to negative, as is the case during storms, and, in the north of Europe, even sometimes in a fall of snow. The sky remained cloudy, and the blast of wind was followed by a dead calm, which lasted all night. The sunset presented a picture of extraordinary magnificence. The thick veil of clouds was rent asunder, as in shreds, quite near the horizon; the sun appeared at 12 degrees of altitude on a sky of indigo-blue. Its disk was enormously enlarged, distorted, and undulated toward the edges. The clouds were gilded; and fascicles of divergent rays, reflect

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ing the most brilliant rainbow hues, extended over the heavens. A great crowd of people assembled in the public square. This celestial phenomenon,—the earthquake,—the thunder which accompanied it,—the red vapour seen during so many days, all were regarded as the effect of the eclipse.

About nine in the evening there was another shock, much slighter than the former, but attended with a subterraneous noise. The barometer was a little lower than usual; but the progress of the horary variations or small atmospheric tides, was no way interrupted. The mercury was precisely at the minimum of height at the moment of the earthquake; it continued rising till eleven in the evening, and sank again till half after four in the morning, conformably to the law which regulates barometrical variations. In the night between the 3rd and 4th of November the reddish vapour was so thick that I could not distinguish the situation of the moon, except by a beautiful halo of 20° diameter.

Scarcely twenty-two months had elapsed since the town of Cumana had been almost totally destroyed by an earthquake. The people regard vapours which obscure the horizon, and the subsidence of wind during the night, as infallible prognostics of disaster. We had frequent visits from persons who wished to know whether our instruments indicated new shocks for the next day; and alarm was great and general when, on the 5th of November, exactly at the same hour as on the preceding day, there was a violent gust of wind, attended by thunder, and a few drops of rain. No shock was felt. The wind and storm returned during five or six days at the same hour, almost at the same minute. The inhabitants of Cumana, and of many other places between the tropics, have long since observed that atmospherical changes, which are, to appearance, the most accidental, succeed each other for whole weeks with astonishing regularity. The same phenomenon occurs in summer, in the temperate zone; nor has it escaped the perception of astronomers, who often observe, in a serene sky, during three or four days successively, clouds which have collected at the same part of the firmament, take the same direction, and dissolve at the same height; sometimes before, sometimes

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after the passage of a star over the meridian, consequently within a few minutes of the same point of true time.*

The earthquake of the 4th of November, the first I had felt, made the greater impression on me, as it was accompanied with remarkable meteorological variations. It was, moreover, a positive movement upward and downward, and not a shock by undulation. I did not then imagine, that after a long abode on the table-lands of Quito and the coasts of Peru, I should become almost as familiar with the abrupt movements of the ground as we are in Europe with the sound of thunder. In the city of Quito, we never thought of rising from our beds when, during the night, subterraneous rumblings (bramidos), which seem always to come from the volcano of Pichincha, announced a shock, the force of which, however, is seldom in proportion to the intensity of the noise. The indifference of the inhabitants, who bear in mind that for three centuries past their city has not been destroyed, readily communicates itself to the least intrepid traveller. It is not so much the fear of the danger, as the novelty of the sensation, which makes so forcible an impression when the effect of the slightest earthquake is felt for the first time.

From our infancy, the idea of certain contrasts becomes fixed in our minds: water appears to us an element that moves; earth, a motionless and inert mass. These impressions are the result of daily experience; they are connected with everything that is transmitted to us by the senses. When the shock of an earthquake is felt, when the earth which we had deemed so stable is shaken on its old foundations, one instant suffices to destroy long-fixed illusions. It is like awakening from a dream; but a painful awakening. We feel that we have been deceived by the apparent stability of nature; we become observant of the least noise; we mistrust for the first time the soil we have so long trod with confidence. But if the shocks be repeated, if they become frequent during several successive days, the uncertainty quickly disappears. In 1784, the inhabitants of Mexico were accustomed to hear the thunder roll beneath

* M. Arago and I paid a great deal of attention to this phenomenon during a long series of observations made in the year 1809 and 1810, at the Observatory of Paris, with the view of verifying the declination of the stars.

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their feet,* as it is heard by us in the region of the clouds. Confidence easily springs up in the human breast: on the coasts of Peru we become accustomed to the undulations of the ground, as the sailor becomes accustomed to the tossing of the ship, caused by the motion of the waves.

The reddish vapour which at Cumana had spread a mist over the horizon a little before sunset, disappeared after the 7th of November. The atmosphere resumed its former purity, and the firmament appeared, at the zenith, of that deep blue tint peculiar to climates where heat, light, and a great equality of electric charge seem all to promote the most perfect dissolution of water in the air. I observed, on the night of the 7th, the immersion of the second satellite of Jupiter. The belts of the planet were more distinct than I had ever seen them before.

I passed a part of the night in comparing the intensity of the light emitted by the beautiful stars which shine in the southern sky. I pursued this task carefully in both hemispheres, at sea, and during my abode at Lima, at Guayaquil, and at Mexico. Nearly half a century has now elapsed since La Caille examined that region of the sky which is invisible in Europe. The stars near the south pole are usually observed with so little perseverance and attention, that the greatest changes may take place in the intensity of t heir light and their own motion, without astronomers having the slightest knowledge of them. I think I have remarked changes of this kind in the constellation of the Crane and in that of the Ship. I compared, at first with the naked eye, the stars which are not very distant from each other, for the purpose of classing them according to the method pointed out by Herschel, in a paper read to the Royal Society of London in 1796. I afterwards employed diaphragms diminishing the aperture of the telescope, and coloured and colourless glasses placed before the eye-glass. I moreover made use of an instrument of reflexion calculated to bring simultaneously two stars into the field of the telescope, after having equalized their light by receiving it with more or fewer rays at pleasure, reflected by the silvered part of the mirror. I admit that these photometric processes are not very precise; but I believe

* Los bramidos de Guanazuato.

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the last, which perhaps had never before been employed, might be rendered nearly exact, by adding a scale of equal parts to the moveable frame of the telescope of the sextant. It was by taking the mean of a great number of valuations, that I saw the relative intensity of the light of the great stars decrease in the following manner: Sirius, Canopus, α Centauri, Acherner, β Centauri, Fomalhaut, Rigel, Procyon, Beteigueuse, ϵ of the Great Dog, δ of the Great Dog, α of the Crane, α of the Peacock. These experiments will become more interesting when travellers shall have determined anew, at intervals of forty or fifty years, some of those changes which the celestial bodies seem to undergo, either at their surface or with respect to their distances from our planetary system.

After having made astronomical observations with the same instruments, in our northern climates and in the torrid zone, we are surprised at the effect produced in the latter (by the transparency of the air, and the less extinction of light), on the clearness with which the double stars, the satellites of Jupiter, or certain nebulæ, present themselves. Beneath a sky equally serene in appearance, it would seem as if more perfect instruments were employed; so much more distinct and well defined do the objects appear between the tropics. It cannot be doubted, that at the period when equinoctial America shall become the centre of extensive civilization, physical astronomy will make immense improvements, in proportion as the skies will be explored with excellent glasses, in the dry and hot climates of Cumana, Coro, and the island of Margareta. I do not here mention the ridge of the Cordilleras, because, with the exception of some high and nearly barren plains in Mexico and Peru, the very elevated table-lands, in which the barometric pressure is from ten to twelve inches less than at the level of the sea, have a misty and extremely variable climate. The extreme purity of the atmosphere which constantly prevails in the low regions during the dry season, counterbalances the elevation of site and the rarity of the air on the table-lands. The elevated strata of the atmosphere, when they envelope the ridges of mountains, undergo rapid changes in their transparency.

The night of the 11th of November was cool and ex-

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tremely fine. From half after two in the morning, the most extraordinary luminous meteors were seen in the direction of the east. M. Bonpland, who had risen to enjoy the freshness of the air, perceived them first. Thousands of bolides and falling stars succeeded each other during the space of four hours. Their direction was very regular from north to south. They filled a space in the sky extending from due east 30° to north and south. In an amplitude of 60° the meteors were seen to rise above the horizon at E.N.E. and at E., to describe arcs more or less extended, and to fall towards the south, after having followed the direction of the meridian. Some of them attained a height of 40°, and all exceeded 25° or 30°. There was very little wind in the low regions of the atmosphere, and that little blew from the east. No trace of clouds was to be seen. M. Bonpland states that, from the first appearance of the phenomenon, there was not in the firmament a space equal in extent to three diameters of the moon, which was not filled every instant with bolides and falling stars. The first were fewer in number, but as they were of different sizes, it was impossible to fix the limit between these two classes of phenomena. All these meteors left luminous traces from five to ten degrees in length, as often happens in the equinoctial regions. The phosphorescence of these traces, or luminous bands, lasted seven or eight seconds. Many of the falling stars had a very distinct nucleus, as large as the disk of Jupiter, from which darted sparks of vivid light. The bolides seem to burst as by explosion; but the largest, those from 1° to 1° 15′ in diameter, disappeared without scintillation, leaving behind them phosphorescent bands (trabes) exceeding in breadth fifteen or twenty minutes. The light of these meteors was white, and not reddish, which must doubtless be attributed to the absence of vapour and the extreme transparency of the air. For the same reason, within the tropics, the stars of the first magnitude have, at their rising, a light decidedly whiter than in Europe.

Almost all the inhabitants of Cumana witnessed this phenomenon, because they had left their houses before four o'clock, to attend the early morning mass. They did not behold these bolides with indifference; the oldest among

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them remembered that the great earthquakes of 1766 were preceded by similar phenomena. The Guaiqueries in the Indian suburb alleged "that the bolides began to appear at one o'clock; and that as they returned from fishing in the gulf, they had perceived very small falling stars towards the east." They assured us that igneous meteors were extremely rare on those coasts after two o'clock in the morning.

The phenomenon ceased by degrees after four o'clock, and the bolides and falling stars became less frequent; but we still distinguished some to north-east by their whitish light, and the rapidity of their movement, a quarter of an hour after sunrise. This circumstance will appear less extraordinary, when I mention that in broad daylight, in 1788, the interior of the houses in the town of Popayan was brightly illumined by an aërolite of immense magnitude. It passed over the town, when the sun was shining clearly, about one o'clock. M. Bonpland and myself, during our second residence at Cumana, after having observed, on the 26th of September, 1800, the immersion of the first satellite of Jupiter, succeeded in seeing the planet distinctly with the naked eye, eighteen minutes after the disk of the sun had appeared in the horizon. There was a very slight vapour in the east, but Jupiter appeared on an azure sky. These facts bear evidence of the extreme purity and transparency of the atmosphere in the torrid zone. The mass of diffused light is the less, in proportion as the vapours are more perfectly dissolved. The same cause which checks the diffusion of the solar light, diminishes the extinction of that which emanates either from bolides from Jupiter, or from the moon, seen on the second day after its conjunction. The 12th of November was an extremely hot day, and the hygrometer indicated a very considerable degree of dryness for those climates. The reddish vapour clouded the horizon anew, and rose to the height of 14°. This was the last time it appeared that year; and I must here observe, that it is no less rare under the fine sky of Cumana, than it is common at Acapulco, on the western coast of Mexico.

We did not neglect, during the course of our journey from Caracas to the Rio Negro, to enquire everywhere,

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whether the meteors of the 12th of November had been perceived. In a wild country, where the greater number of the inhabitants sleep in the open air, so extraordinary a phenomenon could not fail to be remarked, unless it had been concealed from observation by clouds. The Capuchin missionary at San Fernando de Apure,* a village situated amid the savannahs of the province of Varinas; the Franciscan monks stationed near the cataracts of the Orinoco and at Maroa,† on the banks of the Rio Negro; had seen numberless falling-stars and bolides illumine the heavens. Maroa is south-west of Cumana, at one hundred and seventy-four leagues distance. All these observers compared the phenomenon to brilliant fireworks; and it lasted from three till six in the morning. Some of the monks had marked the day in their rituals; others had noted it by the proximate festivals of the Church. Unfortunately, none of them could recollect the direction of the meteors, or their apparent height. From the position of the mountains and thick forests which surround the Missions of the Cataracts and the little village of Maroa, I presume that the bolides were still visible at 20° above the horizon. On my arrival at the southern extremity of Spanish Guiana, at the little fort of San Carlos, I found some Portuguese, who had gone up the Rio Negro from the Mission of St. Joseph of the Maravitans. They assured me that in that part of Brazil the phenomenon had been perceived at least as far as San Gabriel das Cachoeiras, consequently as far as the equator itself.‡

I was forcibly struck by the immense height which these bolides must have attained, to have rendered them visible simultaneously at Cumana, and on the frontiers of Brazil, in a line of two hundred and thirty leagues in length. But what was my astonishment, when, on my return to Europe, I learned that the same phenomenon had been perceived

* N. lat. 7° 53′ 12″; W. long. 70° 20′.
† N. lat. 2° 42′ 0″; W. long. 70° 21′.

‡ A little to the north-west of San Antonio de Castanheiro. I did not meet with any persons who had observed this meteor, at Santa Fé de Bogotá, at Popayan, or in the southern hemisphere, at Quito and Peru. Perhaps the state of the atmosphere, so changeable in these western regions, prevented observation.

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on an extent of the globe of 64° of latitude, and 91° of longitude; at the equator, in South America, at Labrador, and in Germany! I saw accidentally, during my passage from Philadelphia to Bordeaux,* the corresponding observation of Mr. Ellicot (lat. 30° 42); and upon my return from Naples to Berlin, I read the account of the Moravian missionaries among the Esquimaux, in the *Bibliothek* of Göttingen.

The following is a succinct enumeration of the facts: 1st. The fiery meteors were seen in the east, and the east-north-east, at 40° of elevation, from 2ʰ to 6ʰ at Cumana (lat. 10° 27′ 52″, long. 66° 30′); at Porto Cabello (lat. 10° 6′ 52″, long. 67° 5′); and on the frontiers of Brazil, near the equator, in long. 70° west of the meridian of Paris. 2nd. In French Guiana (lat. 4° 56′, long. 54° 35′), "the northern part of the sky was suffused with fire. Numberless falling-stars traversed the heavens during the space of an hour and a half, and shed so vivid a light, that those meteors might be compared to the blazing sheaves which shoot out from fireworks." The knowledge of this fact rests upon the highly trustworthy testimony of the Count de Marbois, then living in exile at Cayenne, a victim to his love of justice and of rational, constitutional liberty. 3rd. Mr. Ellicot, astronomer to the United States, having completed his trigonometric operations for the rectification of the limits on the Ohio, being on the 12th of November in the gulf of Florida, in latitude 25°, and longitude 81° 50′, saw in all parts of the sky, "as many meteors as stars, moving in all directions. Some appeared to fall perpendicularly; and it was expected every minute that they would drop into the vessel." The same phenomenon was perceived upon the American continent as far as latitude 30° 42′, 4th. In Labrador, at Nain (lat. 56° 55′), and Hoffenthal (lat. 58° 4′); in Greenland, at Lichtenau (lat. 61° 5′), and at New Herrnhut (lat. 64° 14′, long. 52° 20′); the Esquimaux were terrified at the enormous quantity of bolides which fell during twilight at all points of the firmament, and some of which were said to be a foot broad. 5th. In

* In the Memoirs of the Pennsylvanian Society.

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Germany, Mr. Zeissing, vicar of Ittetsadt, near Weimar (lat. 50° 59′, long. 9° 1′ east), perceived, on the 12th of November, between the hours of six and seven in the morning (half-past two at Cumana), some falling-stars which shed a very white light. Soon after, in the direction of south and south-west, luminous rays appeared from four to six feet long; they were reddish, and resembled the luminous track of a sky-rocket. During the morning twilight, between the hours of seven and eight, the sky, in the direction of south-west, was observed from time to time to be brightly illumined by white lightning, running in serpentine lines along the horizon. At night the cold increased and the barometer rose. It is very probable, that the meteors might have been observed more to the east, in Poland and in Russia.*

The distance from Weimar to the Rio Negro is 1800 nautical leagues; and from the Rio Negro to Herrnhut in Greenland, 1300 leagues. Admitting that the same fiery meteors were seen at points so distant from each other, we must suppose that their height was at least 411 leagues. Near Weimar, the appearance like sky-rockets was observed in the south and south-east; at Cumana, in the east and east-north-east. We may therefore conclude, that numberless aërolites must have fallen into the sea, between Africa and South America, westward of the Cape Verd Islands. But since the direction of the bolides was not the same at Labrador and at Cumana, why were they not perceived in the latter place towards the north, as at Cayenne? We can scarcely be too cautious on a subject, on which good observations made in very distant places are still wanting. I am rather inclined to think, that the Chayma Indians of Cumana did not see the same bolides as the Portuguese in Brazil and the missionaries in Labrador; but at the same time it cannot be doubted (and this fact appears to me very remarkable) that in the New World, between the meridians of 46° and 82°, between the equator and 64° north, at the same hour, an

* In Paris and in London the sky was cloudy. At Carlsruhe, before dawn, lightning was seen in the north-west and south-east. On the 13th of November a remarkable glare of light was seen at the same place in the south-east.

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immense number of bolides and falling-stars were perceived; and that those meteors had everywhere the same brilliancy, throughout a space of 921,000 square leagues.

Astronomers who have lately been directing minute attention to falling-stars and their parallaxes, consider them as meteors belonging to the farthest limits of our atmosphere, between the region of the Aurora Borealis and that of the lightest clouds.* Some have been seen, which had not more than 14,000 toises, or about five leagues of elevation. The highest do not appear to exceed thirty leagues. They are often more than a hundred feet in diameter: and their swiftness is such, that they dart in a few seconds through a space of two leagues. Of some which have been measured, the direction was almost perpendicularly upward, or forming an angle of 50° with the vertical line. This extremely remarkable circumstance has led to the conclusion, that falling-stars are not aërolites which, after having hovered a long time in space, unite on accidentally entering into our atmosphere, and fall towards the earth.†

Whatever may be the origin of these luminous meteors, it is difficult to conceive an instantaneous inflammation taking place in a region where there is less air than in the vacuum of our air-pumps; and where (at the height of 25,000 toises) the mercury in the barometer would not rise to 0·012 of a line. We have ascertained the uniform mixture of atmospheric air to be about 0·003, only to an elevation of 3000 toises; consequently not beyond the last stratum of fleecy clouds. It may be admitted that, in the first revolutions of the globe, gaseous substances, which yet remain unknown to us, have risen towards that region through which the falling-stars pass; but accurate experiments, made upon mixtures of gases which have not the same specific gravity, show that there is no reason for supposing a superior stratum of the atmosphere entirely different from the inferior strata. Gaseous substances mingle and penetrate each other on the

* According to the observations which I made on the ridge of the Andes, at an elevation of 2700 toises, on the *moutons*, or little white fleecy clouds, it appeared to me, that their elevation is sometimes not less than 6000 toises above the level of the coast.

† M. Chladni, who at first considered falling-stars to be aërolites, subsequently abandoned that idea.

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least movement; and a uniformity of their mixture may have taken place in the lapse of ages, unless we believe them to possess a repulsive action of which there is no example in those substances we can subject to our observations. Farther, if we admit the existence of particular aërial fluids in the inaccessible regions of luminous meteors, of falling-stars, bolides, and the Aurora Borealis; how can we conceive why the whole stratum of those fluids does not at once ignite, but that the gaseous emanations, like the clouds, occupy only limited spaces? How can we suppose an electrical explosion without some vapours collected together, capable of containing unequal charges of electricity, in air, the mean temperature of which is perhaps 25° below the freezing point of the centigrade thermometer, and the rarefaction of which is so considerable, that the compression of the electrical shock could scarcely disengage any heat? These difficulties would in great part be removed, if the direction of the movement of falling-stars allowed us to consider them as bodies with a solid nucleus, as cosmic phenomena (belonging to space beyond the limits of our atmosphere), and not as telluric phenomena (belonging to our planet only).

Supposing the meteors of Cumana to have been only at the usual height at which falling-stars in general move, the same meteors were seen above the horizon in places more than 310 leagues distant from each other.* How great a disposition to incandescence must have prevailed on the 12th November, in the higher regions of the atmosphere, to have rendered during four hours myriads of bolides and falling stars visible at the equator, in Greenland, and in Germany!

M. Benzenberg observes, that the same cause which renders the phenomenon more frequent, has also an influence on the large size of the meteors, and the intensity of their light. In Europe, the greatest number of falling stars are seen on those nights on which very bright ones are mingled with very small ones. The periodical nature of the phenomenon augments the interest it excites. There are months in which M. Brandes has reckoned in our temperate zone only sixty or eighty falling-stars in one night; and in other months

* It was this circumstance that induced Lambert to propose the observation of falling-stars for the determination of terrestrial longitudes. He considered them to be celestial signals seen at great distances.

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their number has risen to two thousand. Whenever one is observed, which has the diameter of Sirius or of Jupiter, we are sure of seeing the brilliant meteor succeeded by a great number of smaller ones. If the falling stars be very numerous during one night, it is probable that they will continue equally so during several weeks. It would seem, that in the higher regions of the atmosphere, near that extreme limit where the centrifugal force is balanced by gravity, there exists at regular periods a particular disposition for the production of bolides, falling-stars, and the Aurora Borealis.* Does the periodical recurrence of this great phenomenon depend upon the state of the atmosphere? or upon something which the atmosphere receives from without, while the earth advances in the ecliptic? Of all this we are still as ignorant as mankind were in the days of Anaxagoras.

With respect to the falling-stars themselves, it appears to me, from my own experience, that they are more frequent in the equinoctial regions than in the temperate zone; and more frequent above continents, and near certain coasts, than in the middle of the ocean. Do the radiation of the surface of the globe, and the electric charge of the lower regions of the atmosphere (which varies according to the nature of the soil and the positions of the continents and seas), exert their influence as far as those heights where eternal winter reigns? The total absence of even the smallest clouds, at certain seasons, or above some barren plains destitute of vegetation, seems to prove that this influence can be felt as far as five or six thousand toises high.

A phenomenon analogous to that which appeared on the 12th of November at Cumana, was observed thirty years previously on the table-land of the Andes, in a country studded with volcanoes. In the city of Quito there was seen in one part of the sky, above the volcano of Cayamba, such great numbers of falling-stars, that the mountain was thought to be in flames. This singular sight lasted more than an hour. The people assembled in the plain of Exido,

* Ritter, like several others, makes a distinction between bolides mingled with falling-stars and those luminous meteors which, enveloped in vapour and smoke, explode with great noise, and let fall (chiefly in the day-time) aërolites. The latter certainly do not belong to our atmosphere.

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which commands a magnificent view of the highest summits of the Cordilleras. A procession was on the point of setting out from the convent of San Francisco, when it was perceived that the blaze on the horizon was caused by fiery meteors, which ran along the skies in all directions, at the altitude of twelve or thirteen degrees.

Chapter XI.

Passage from Cumana to La Guayra.—Morro of New Barcelona.—Cape Codera.—Road from La Guayra to Caracas.

On the 16th of November, at eight in the evening, we were under sail to proceed along the coast from Cumana to the port of La Guayra, whence the inhabitants of the province of Venezuela export the greater part of their produce. The passage is only a distance of sixty leagues, and it usually occupies from thirty-six to forty hours. The little coasting vessels are favoured at once by the wind and by the currents, which run with more or less force from east to west, along the coasts of Terra Firma, particularly from cape Paria to the cape of Chichibacoa. The road by land from Cumana to New Barcelona, and thence to Caracas, is nearly in the same state as that in which it was before the discovery of America. The traveller has to contend with the obstacles presented by a miry soil, large scattered rocks, and strong vegetation. He must sleep in the open air, pass through the valleys of the Unare, the Tuy, and the Capaya, and cross torrents which swell rapidly on account of the proximity of the mountains. To these obstacles must be added the dangers arising from the extreme insalubrity of the country. The very low lands, between the sea-shore and the chain of hills nearest the coast, from the bay of Mochima as far as Coro, are extremely unhealthy. But the last-mentioned town, which is surrounded by an immense wood of thorny cactuses, owes its great salubrity, like Cumana, to its barren soil and the absence of rain.

In returning from Caracas to Cumana, the road by land is

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sometimes preferred to the passage by sea, to avoid the adverse current. The postman from Caracas is nine days in performing this journey. We often saw persons, who had followed him, arrive at Cumana ill of nervous and miasmatic fevers. The tree of which the bark* furnishes a salutary remedy for those fevers, grows in the same valleys, and upon the edge of the same forests which send forth the pernicious exhalations. M. Bonpland recognised the cuspare in the vegetation of the gulf of Santa Fé, situated between the ports of Cumana and Barcelona. The sickly traveller may perchance repose in a cottage, the inhabitants of which are ignorant of the febrifuge qualities of the trees that shade the surrounding valleys.

Having proceeded by sea from Cumana to La Guayra, we intended to take up our abode in the town of Caracas, till the end of the rainy season. From Caracas we proposed to direct our course across the great plains or llanos, to the Missions of the Orinoco; to go up that vast river, to the south of the cataracts, as far as the Rio Negro and the frontiers of Brazil; and thence to return to Cumana by the capital of Spanish Guiana, commonly called, on account of its situation, Angostura, or the Strait. We could not determine the time we might require to accomplish a tour of seven hundred leagues, more than two-thirds of that distance having to be traversed in boats. The only parts of the Orinoco known on the coasts are those near its mouth. No commercial intercourse is kept up with the Missions. The whole of the country beyond the llanos is unknown to the inhabitants of Cumana and Caracas. Some think that the plains of Calabozo, covered with turf, stretch eight hundred leagues southward, communicating with the Steppes or Pampas of Buenos Ayres; others, recalling to mind the great mortality which prevailed among the troops of Iturriaga and Solano, during their expedition to the Orinoco, consider the whole country, south of the cataracts of Atures, as extremely pernicious to health. In a region where travelling is so uncommon, people seem to feel a pleasure in exaggerating to strangers the difficulties arising from the climate, the wild animals, and the Indians. Nevertheless we persisted in the project we

* Cortex Angosturæ of our pharmacopœias, the bark of the Bonplandia trifoliata.

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had formed. We could rely upon the interest and solicitude of the governor of Cumana, Don Vicente Emparan, as well as on the recommendations of the Franciscan monks, who are in reality masters of the shores of the Orinoco.

Fortunately for us, one of those monks, Juan Gonzales, was at that time in Cumana. This young monk, who was only a lay-brother, was highly intelligent, and full of spirit and courage. He had the misfortune shortly after his arrival on the coast to displease his superiors, upon the election of a new director of the Missions of Piritu, which is a period of great agitation in the convent of New Barcelona. The triumphant party exercised a general retaliation, from which the lay-brother could not escape. He was sent to Esmeralda, the last Mission of the Upper Orinoco, famous for the vast quantity of noxious insects with which the air is continually filled. Fray Juan Gonzales was thoroughly acquainted with the forests which extend from the cataracts towards the sources of the Orinoco. Another revolution in the republican government of the monks had some years before brought him to the coast, where he enjoyed (and most justly) the esteem of his superiors. He confirmed us in our desire of examining the much-disputed bifurcation of the Orinoco. He gave us useful advice for the preservation of our health, in climates where he had himself suffered long from intermitting fevers. We had the satisfaction of finding Fray Juan Gonzales at New Barcelona, on our return from the Rio Negro. Intending to go from the Havannah to Cadiz, he obligingly offered to take charge of part of our herbals, and our insects of the Orinoco; but these collections were unfortunately lost with himself at sea. This excellent young man, who was much attached to us, and whose zeal and courage might have rendered him very serviceable to the missions of his order, perished in a storm on the coast of Africa, in 1801.

The boat which conveyed us from Cumana to La Guayra, was one of those employed in trading between the coasts and the West India Islands. They are thirty feet long, and not more than three feet high at the gunwale; they have no decks, and their burthen is generally from two hundred to two hundred and fifty quintals. Although the sea is extremely rough from Cape Codera to La Guayra, and although

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the boats have an enormous triangular sail, somewhat dangerous in those gusts which issue from the mountain-passes, no instance has occurred during thirty years, of one of these boats being lost in the passage from Cumana to the coast of Caracas. The skill of the Guaiqueria pilots is so great, that accidents are very rare, even in the frequent trips they make from Cumana to Guadaloupe, or the Danish islands, which are surrounded with breakers. These voyages of 120 or 150 leagues, in an open sea, out of sight of land, are performed in boats without decks, like those of the ancients, without observations of the meridian altitude of the sun, without charts, and generally without a compass. The Indian pilot directs his course at night by the pole-star, and in the daytime by the sun and the wind. I have seen Guaiqueries and pilots of the Zambo caste, who could find the pole-star by the direction of the pointers α and β of the Great Bear, and they seemed to me to steer less from the view of the pole-star itself, than from the line drawn through these stars. It is surprising, that at the first sight of land, they can find the island of Guadaloupe, Santa Cruz, or Porto Rico; but the compensation of the errors of their course is not always equally fortunate. The boats, if they fall to leeward in making land, beat up with great difficulty to the eastward, against the wind and the current.

We descended rapidly the little river Manzanares, the windings of which are marked by cocoa-trees, as the rivers of Europe are sometimes bordered by poplars and old willows. On the adjacent arid land, the thorny bushes, on which by day nothing is visible but dust, glitter during the night with thousands of luminous sparks. The number of phosphorescent insects augments in the stormy season. The traveller in the equinoctial regions is never weary of admiring the effect of those reddish and moveable fires, which, being reflected by limpid water, blend their radiance with that of the starry vault of heaven.

We quitted the shore of Cumana as if it had long been our home. This was the first land we had trodden in a zone, towards which my thoughts had been directed from earliest youth. There is a powerful charm in the impression produced by the scenery and climate of these regions; and after an abode of a few months we seemed to have lived there

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during a long succession of years. In Europe, the inhabitant of the north feels an almost similar emotion, when he quits even after a short abode the shores of the Bay of Naples, the delicious country between Tivoli and the lake of Nemi, or the wild and majestic scenery of the Upper Alps and the Pyrenees. Yet everywhere in the temperate zone, the effects of vegetable physiognomy afford little contrast. The firs and the oaks which crown the mountains of Sweden have a certain family air in common with those which adorn Greece and Italy. Between the tropics, on the contrary, in the lower regions of both Indies, everything in nature appears new and marvellous. In the open plains and amid the gloom of forests, almost all the remembrances of Europe are effaced; for it is vegetation that determines the character of a landscape, and acts upon the imagination by its mass, the contrast of its forms, and the glow of its colours. In proportion as impressions are powerful and new, they weaken antecedent impressions, and their force imparts to them the character of duration. I appeal to those who, more sensible to the beauties of nature than to the charms of society, have long resided in the torrid zone. How dear, how memorable during life, is the land on which they first disembarked! A vague desire to revisit that spot remains rooted in their minds to the most advanced age. Cumana and its dusty soil are still more frequently present to my imigination, than all the wonders of the Cordilleras. Beneath the bright sky of the south, the light, and the magic of the aërial hues, embellish a land almost destitute of vegetation. The sun does not merely enlighten, it colours the objects, and wraps them in a thin vapour, which, without changing the transparency of the air, renders its tints more harmonious, softens the effects of the light, and diffuses over nature a placid calm, which is reflected in our souls. To explain this vivid impression which the aspect of the scenery in the two Indies produces, even on coasts but thinly wooded, it is sufficient to recollect that the beauty of the sky augments from Naples to the equator, almost as much as from Provence to the south of Italy.

We passed at high water the bar formed at the mouth of the little river Manzanares. The evening breeze gently swelled the waves in the gulf of Cariaco. The moon had

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not risen, but that part of the milky way which extends from the feet of the Centaur towards the constellation of Sagittarius, seemed to pour a silvery light over the surface of the ocean. The white rock, crowned by the castle of San Antonio, appeared from time to time between the high tops of the cocoa-trees which border the shore; and we soon recognized the coasts only by the scattered lights of the Guaiqueria fishermen.

We sailed at first to N. N. W., approaching the peninsula of Araya; we then ran thirty miles to W. and W.S.W. As we advanced towards the shoal that surrounds Cape Arenas and stretches as far as the petroleum springs of Maniquarez, we enjoyed one of those varied sights which the great phosphorescence of the sea so often displays in those climates. Bands of porpoises followed our bark. Fifteen or sixteen of these animals swam at equal distances from each other. When turning on their backs, they struck the surface of the water with their broad tails; they diffused a brilliant light, which seemed like flames issuing from the depth of the ocean.* Each band of porpoises, ploughing the surface of the waters, left behind it a track of light, the more striking as the rest of the sea was not phosphorescent. As the motion of an oar, and the track of the bark, produced on that night but feeble sparks, it is natural to suppose that the vivid phosphorescence caused by the porpoises was owing not only to the stroke of their tails, but also to the gelatinous matter that envelopes their bodies, and is detached by the shock of the waves.

We found ourselves at midnight between some barren and rocky islands, which uprise like bastions in the middle of the sea, and form the group of the Caracas and Chimanas.† The moon was above the horizon, and lighted up these cleft rocks which are bare of vegetation and of fantastic aspect. The sea here forms a sort of bay, a slight inward curve of the land between Cumana and Cape Codera. The islets of Picua, Picuita, Caracas, and Boracha, appear like fragments of the ancient coast, which stretches from Bordones in the same direction east and west. The gulfs of Mochima and Santa Fé, which will no doubt one day become frequented

* See Views of Nature, (Bohn's edition,) p. 246.

† There are three of the Caracas islands and eight of the Chimanas.

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ports, lie behind those little islands. The rents in the land, the fracture and dip of the strata, all here denote the effects of a great revolution: possibly that which clove asunder the chain of the primitive mountains, and separated the mica-schist of Araya and the island of Margareta from the gneiss of Cape Codera. Several of the islands are visible at Cumana, from the terraces of the houses, and they produce, according to the superposition of layers of air more or less heated, the most singular effects of suspension and mirage. The height of the rocks does not probably exceed one hundred and fifty toises; but at night, when lighted by the moon, they seem to be of a very considerable elevation.

It may appear extraordinary, to find the Caracas Islands so distant from the city of that name, opposite the coast of the Cumanagotos; but the denomination of Caracas denoted at the beginning of the Conquest, not a particular spot, but a tribe of Indians, neighbours of the Tecs, the Taramaynas, and the Chagaragates. As we came very near this group of mountainous islands, we were becalmed; and at sunrise, small currents drifted us toward Boracha, the largest of them. As the rocks rise nearly perpendicular, the shore is abrupt; and in a subsequent voyage I saw frigates at anchor almost touching the land. The temperature of the atmosphere became sensibly higher whilst we were sailing among the islands of this little archipelago. The rocks, heated during the day, throw out at night, by radiation, a part of the heat absorbed. As the sun arose on the horizon, the rugged mountains projected their vast shadows on the surface of the ocean. The flamingoes began to fish in places where they found in a creek calcareous rocks bordered by a narrow beach. All these islands are now entirely uninhabited; but upon one of the Caracas are found wild goats of large size, brown, and extremely swift. Our Indian pilot assured us that their flesh has an excellent flavour. Thirty years ago a family of whites settled on this island, where they cultivated maize and cassava. The father alone survived his children. As his wealth increased, he purchased two black slaves; and by these slaves he was murdered. The goats became wild, but the cultivated plants perished. Maize in America, like wheat in Europe, connected with man since his first migrations, appears to be preserved only by his care. We some-

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times see these nutritive gramina disseminate themselves; but when left to nature the birds prevent their reproduction by destroying the seeds.

We anchored for some hours in the road of New Barcelona, at the mouth of the river Neveri, of which the Indian (Cumanagoto) name is Enipiricuar. This river is full of crocodiles, which sometimes extend their excursions into the open sea, especially in calm weather. They are of the species common in the Orinoco, and bear so much resemblance to the crocodile of Egypt, that they have long been confounded together. It may easily be conceived that an animal, the body of which is surrounded with a kind of armour, must be nearly indifferent to the saltness of the water. Pigafetta relates in his journal recently published at Milan that he saw, on the shores of the island of Borneo, crocodiles which inhabit alike land and sea. These facts must be interesting to geologists, since attention has been fixed on the fresh-water formations, and the curious mixture of marine and fluviatile petrifactions sometimes observed in certain very recent rocks.

The port of Barcelona has maintained a very active commerce since 1795. From Barcelona is exported most of the produce of those vast steppes which extend from the south side of the chain of the coast as far as the Orinoco, and in which cattle of every kind are almost as abundant as in the Pampas of Buenos Ayres. The commercial industry of these countries depends on the demand in the West India Islands for salted provision, oxen, mules, and horses. The coasts of Terra Firma being opposite to the island of Cuba, at a distance of fifteen or eighteen days' sail, the merchants of the Havannah prefer, especially in time of peace, obtaining their provision from the port of Barcelona, to the risk of a long voyage in another hemisphere to the mouth of the Rio de la Plata. The situation of Barcelona is singularly advantageous for the trade in cattle. The animals have only three days' journey from the llanos to the port, while it requires eight or nine days to reach Cumana, on account of the chain of mountains of the Brigantine and the Imposible.

Having landed on the right bank of the Neveri, we ascended to a little fort called El Morro de Barcelona, situated at the elevation of sixty or seventy toises above the level of

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the sea. The Morro is a calcareous rock which has been lately fortified.

The view from the summit of the Morro is not without beauty. The rocky island of Boracha lies on the east, the lofty promontory of Unare is on the west, and below are seen the mouth of the river Neveri, and the arid shores on which the crocodiles come to sleep in the sun. Notwithstanding the extreme heat of the air, for the thermometer, exposed to the reflection of the white calcareous rock, rose to 38°, we traversed the whole of the eminence. A fortunate chance led us to observe some very curious geological phenomena, which we again met with in the Cordilleras of Mexico. The limestone of Barcelona has a dull, even, or conchoidal fracture, with very flat cavities. It is divided into very thin strata, and exhibits less analogy with the limestone of Cumanacoa, than with that of Caripe, forming the cavern of the Guacharo. It is traversed by banks of schistose jasper,* black, with a conchoidal fracture, and breaking into fragments of a parallelopipedal figure. This fossil does not exhibit those little streaks of quartz so common in the Lydian stone. It is found decomposed at its surface into a yellowish grey crust, and it does not act upon the magnet. Its edges, a little translucid, give it some resemblance to the hornstone, so common in secondary limestones.† It is remarkable that we find the schistose jasper which in Europe characterizes the transition rocks,‡ in a limestone having great analogy with that of Jura. In the study of formations, which is the great end of geognosy, the knowledge acquired in the old and new worlds should be made to furnish reciprocal aid to each other. It appears that these black strata are found also in the calcareous mountains of the island of Boracha.§ Another jasper, that known by the name of the Egyptian pebble, was found by M. Bonpland near the Indian village of Curacatiche or

* Kieselschiefer of Werner.

† In Switzerland, the hornstone passing into common jasper is found in kidney-stones, and in layers both in the Alpine and Jura limestone, especially in the former.

‡ The transition-limestone and schist.

§ We saw some of it as ballast, in a fishing-boat at Punta Araya. Its fragments might have been mistaken for basalt.

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Curacaguitiche, fifteen leagues south of the Morro of Barcelona, when, on our return from the Orinoco, we crossed the llanos, and approached the mountains on the coast. This stone presented yellowish concentric lines and bands, on a reddish brown ground. It appeared to me that the round pieces of Egyptian jasper belonged also to the Barcelona limestone. Yet, according to M. Cordier, the fine pebbles of Suez owe their origin to a breccia formation, or siliceous agglomerate.

At the moment of our setting sail, on the 19th of November, at noon, I took some altitudes of the moon, to determine the longitude of the Morro. The difference of meridian between Cumana and the town of Barcelona, where I made a great number of astronomical observations in 1800, is 34′ 48″. I found the dip of the needle 42·20°: the intensity of the forces was equal to 224 oscillations.

From the Morro of Barcelona to Cape Codera, the land becomes low, as it recedes southward; and the soundings extend to the distance of three miles. Beyond this we find the bottom at forty-five or fifty fathoms. The temperature of the sea at its surface was 25·9°; but when we were passing through the narrow channel which separates the two Piritu Islands, in three fathoms water, the thermometer was only 24·5°. The difference would perhaps be greater, if the current, which runs rapidly westward, stirred up deeper water; and if, in a pass of such small width, the land did not contribute to raise the temperature of the sea. The Piritu Islands resemble those shoals which become visible when the tide falls. They do not rise more than eight or nine inches above the mean height of the sea. Their surface is smooth, and covered with grass. We might have thought we were gazing on some of our own northern meadows. The disk of the setting sun appeared like a globe of fire suspended over the savannah; and its last rays, as they swept the earth, illumined the grass, which was at the same time agitated by the evening breeze. In the low and humid parts of the equinoctial zone, even when the gramineous plants and reeds present the aspect of a meadow, a rich accessory of the picture is usually wanting; I allude to that variety of wild flowers, which,

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scarcely rising above the grass, seem as it were, to lie upon a smooth bed of verdure. Within the tropics, the strength and luxury of vegetation give such a development to plants, that the smallest of the dicotyledonous family become shrubs. It would seem as if the liliaceous plants, mingling with the gramina, assumed the place of the flowers of our meadows. Their form is indeed striking; they dazzle by the variety and splendour of their colours; but being too high above the soil, they disturb that harmonious proportion which characterizes the plants of our European meadows. Nature has in every zone stamped on the landscape the peculiar type of beauty proper to the locality.

We must not be surprised that fertile islands, so near Terra Firma, are not now inhabited. It was only at the early period of the discovery, and whilst the Caribbees, Chaymas, and Cumanagotos were still masters of the coast, that the Spaniards formed settlements at Cubagua and Margareta. When the natives were subdued, or driven southward in the direction of the savannahs, the preference was given to settlements on the continent, where there was a choice of land, and where there were Indians, who might be treated like beasts of burden. Had the little islands of Tortuga, Blanquilla, and Orchilla been situated in the group of the Antilles, they would not have remained without traces of cultivation.

Vessels of heavy burthen pass between the main land and the most southern of the Piritu Islands. Being very low, their northern point is dreaded by pilots who near the coast in those latitudes. When we found ourselves to westward of the Morro of Barcelona, and the mouth of the river Unare, the sea, till then calm, became agitated and rough in proportion as we approached Cape Codera. The influence of that vast promontory is felt from afar, in that part of the Caribbean Sea. The length of the passage from Cumana to La Guayra depends on the degree of ease or difficulty with which Cape Codera can be doubled. Beyond this cape the sea constantly runs so high, that we can scarcely believe we are near a coast where (from the point of Paria as far as Cape San Roman) a gale of wind is never known. On the 20th of November at sunrise we were so far advanced, that we might expect

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to double the cape in a few hours. We hoped to reach La Guayra the same day; but our Indian pilot being afraid of the privateers who were near that port, thought it would be prudent to make for land, and anchor in the little harbour of Higuerote, which we had already passed, and await the shelter of night to proceed on our voyage.

On the 20th of November at nine in the morning we were at anchor in the bay just mentioned, situated westward of the mouth of the Rio Capaya. We found there neither village nor farm, but merely two or three huts, inhabited by Mestizo fishermen. Their livid hue, and the meagre condition of their children, sufficed to remind us that this spot is one of the most unhealthy of the whole coast. The sea has so little depth along these shores, that even with the smallest barks it is impossible to reach the shore without wading through the water. The forests come down nearly to the beach, which is covered with thickets of mangroves, avicennias, manchineel-trees, and that species of suriana which the natives call *romero de la mar*.* To these thickets, and particularly to the exhalations of the mangroves, the extreme insalubrity of the air is attributed here, as in other places in both Indies. On quitting the boats, and whilst we were yet fifteen or twenty toises distant from land, we perceived a faint and sickly smell, which reminded me of that diffused through the galleries of deserted mines, where the lights begin to be extinguished, and the timber is covered with flocculent byssus. The temperature of the air rose to 34°, heated by the reverberation from the white sands which form a line between the mangroves and the great trees of the forest. As the shore descends with a gentle slope, small tides are sufficient alternately to cover and uncover the roots and part of the trunks of the mangroves. It is doubtless whilst the sun heats the humid wood, and causes the fermentation, as it were, of the ground, of the remains of dead leaves and of the molluscs enveloped in the drift of floating seaweed, that those deleterious gases are formed, which escape our researches. We observed that the sea-water, along the whole coast, acquired a yellowish brown tint, wherever it came into contact with the mangrove trees.

* Suriana maritima.

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Struck with this phenomenon, I gathered at Higuerote a considerable quantity of branches and roots, for the purpose of making some experiments on the infusion of the mangrove, on my arrival at Caracas. The infusion in warm water had a brown colour and an astringent taste. It contained a mixture of extractive matter and tannin. The rhizophora, the misletoe, the cornel-tree, in short, all the plants which belong to the natural families of the lorantheous and the caprifoliaceous plants, have the same properties. The infusion of mangrove-wood, kept in contact with atmospheric air under a glass jar for twelve days, was not sensibly deteriorated in purity. A little blackish flocculent sediment was formed, but it was attended by no sensible absorption of oxygen. The wood and roots of the mangrove placed under water were exposed to the rays of the sun. I tried to imitate the daily operations of nature on the coasts at the rise of the tide. Bubbles of air were disengaged, and at the expiration of ten days they formed a volume of thirty-three cubic inches. They were a mixture of azotic gas and carbonic acid. Nitrous gas scarcely indicated the presence of oxygen.* Lastly, I set the wood and the roots of the mangrove thoroughly wetted, to act on a given volume of atmospheric air in a phial with a ground-glass stopple. The whole of the oxygen disappeared; and, far from being superseded by carbonic acid, lime-water indicated only 0·02. There was even a dimunition of the volume of air, more than correspondent with the oxygen absorbed. These slight experiments led me to conclude that it is the moistened bark and wood which act upon the atmosphere in the forests of mangrove-trees, and not the water strongly tinged with yellow, forming a distinct band along the coasts. In pursuing the different stages of the decomposition of the ligneous matter, I observed no appearance of a disengagement of sulphuretted hydrogen, to which many travellers attribute the smell perceived amidst mangroves. The decomposition of the earthy and alkaline sulphates, and their transition to the state of sulphurets, may no doubt favour this disengagement in many littoral and marine plants; for instance, in the fuci: but I am rather inclined to think that the rhizophora, the avicen-

* In a hundred parts there were eighty-four of nitrogen, fifteen of carbonic acid gas that the water had not absorbed, and one of oxygen.

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nia, and the conocarpus, augment the insalubrity of the air by the animal matter which they contain conjointly with tannin. These shrubs belong to the three natural families of the Loranthæ, the Combretaceæ, and the Pyrenaceæ, in which the astringent principle abounds; this principle accompanies gelatin, even in the bark of beech, alder, and nut-trees.

Moreover, a thick wood spreading over marshy grounds would diffuse noxious exhalations in the atmosphere, even though that wood were composed of trees possessing in themselves no deleterious properties. Wherever mangroves grow on the sea-shore, the beach is covered with infinite numbers of molluscs and insects. These animals love shade and faint light, and they find themselves sheltered from the shock of the waves amid the scaffolding of thick and intertwining roots, which rises like lattice-work above the surface of the waters. Shell-fish cling to this lattice; crabs nestle in the hollow trunks; and the seaweeds, drifted to the coast by the winds and tides, remain suspended on the branches which incline towards the earth. Thus, maritime forests, by the accumulation of a slimy mud between the roots of the trees, increase the extent of land. But whilst these forests gain on the sea, they do not enlarge their own dimensions; on the contrary, their progress is the cause of their destruction. Mangroves, and other plants with which they live constantly in society, perish in proportion as the ground dries and they are no longer bathed with salt water. Their old trunks, covered with shells, and half-buried in the sand, denote, after the lapse of ages, the path they have followed in their migrations, and the limits of the land which they have wrested from the ocean.

The bay of Higuerote is favourably situated for examining Cape Codera, which is there seen in its full extent seven miles distant. This promontory is more remarkable for its size than for its elevation, being only about two hundred toises high. It is perpendicular on the north-west and east. In these grand profiles the dip of the strata appears to be distinguishable. Judging from the fragments of rock found along the coast, and from the hills near Higuerote, Cape Codera is not composed of granite with a granular texture, but of a real gneiss with a foliated texture. Its laminæ are

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very broad and sometimes sinuous.* They contain large nodules of reddish feldspar and but little quartz. The mica is found in superposed lamellæ, not isolated. The strata nearest the bay were in the direction of 60° N.E., and dipped 80° to N.W. These relations of direction and of dip are the same at the great mountain of the Silla, near Caracas, and to the east of Maniquarez, in the isthmus of Araya. They seem to prove that the primitive chain of that isthmus, after having been ruptured or swallowed up by the sea along a space of thirty-five leagues,† appears anew in Cape Codera, and continues westward as a chain of the coast.

I was assured that, in the interior of the earth, south of Higuerote, limestone formations are found. The gneiss did not act upon the magnetic needle; yet along the coast, which forms a cove near Cape Codera, and which is covered with a fine forest, I saw magnetic sand mixed with spangles of mica, deposited by the sea. This phenomenon occurs again near the port of La Guayra. Possibly it may denote the existence of some strata of hornblende-schist covered by the waters, in which schist the sand is disseminated. Cape Codera forms on the north an immense spherical segment. A shallow which stretches along its foot is known to navigators by the name of the points of Tutumo and of San Francisco.

The road by land from Higuerote to Caracas, runs through a wild and humid tract of country, by the Montaña of Capaya, north of Caucagua, and the valley of Rio Guatira and Guarenas. Some of our fellow-travellers determined on taking this road, and M. Bonpland also preferred it, notwithstanding the continual rains and the overflowing of the rivers. It afforded him the opportunity of making a rich collection of new plants.‡ For my part, I continued alone with the Guaiqueria pilot the voyage by sea; for I thought it hazardous to lose sight of the instruments which we were to make use of on the banks of the Orinoco.

We set sail at night-fall. The wind was unfavourable, and we doubled Cape Codera with difficulty. The surges were

* Dickflasriger gneiss.

† Between the meridians of Maniquarez and Higuerote.

‡ Bauhinia ferruginea, Browne racemosa, Bred. Inga hymenaelfolia J. curiepensis (which Willdenouw has called by mistake I. caripensis), &c.

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short, and often broke one upon another. The sea ran the higher, owing to the wind being contrary to the current, till after midnight. The general motion of the waters within the tropics towards the west is felt strongly on the coast during two-thirds of the year. In the months of September, October, and November, the current often flows eastward for fifteen or twenty days in succession; and vessels on their way from Guayra to Porto Cabello have sometimes been unable to stem the current which runs from west to east, although they have had the wind astern. The cause of these anomalies is not yet discovered. The pilots think they are the effect of gales of wind from the north-west in the gulf of Mexico.

On the 21st of November, at sunrise, we were to the west of Cape Codera, opposite Curuao. The coast is rocky and very elevated, the scenery at once wild and picturesque. We were sufficiently near land to distinguish scattered huts surrounded by cocoa-trees, and masses of vegetation, which stood out from the dark ground of the rocks. The mountains are everywhere perpendicular, and three or four thousand feet high; their sides cast broad and deep shadows upon the humid land, which stretches out to the sea, glowing with the freshest verdure. This shore produces most of those fruits of the hot regions, which are seen in such great abundance in the markets of the Caracas. The fields cultivated with sugar-cane and maize, between Camburi and Niguatar, stretch through narrow valleys, looking like crevices or clefts in the rocks: and penetrated by the rays of the sun, then above the horizon, they presented the most singular contrasts of light and shade.

The mountain of Niguatar and the Silla of Caracas are the loftiest summits of this littoral chain. The first almost reaches the height of Canigou; it seems as if the Pyrenees or the Alps, stripped of their snows, had risen from the bosom of the ocean; so much more stupendous do mountains appear when viewed for the first time from the sea. Near Caravalleda, the cultivated lands enlarge; we find hills with gentle declivities, and the vegetation rises to a great height. The sugar-cane is here cultivated, and the monks of La Merced have a plantation with two hundred slaves. This spot was formerly extremely subject to fever; and it is

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said that the air has acquired salubrity since trees have been planted round a small lake, the emanations of which were dreaded, and which is now less exposed to the ardour of the sun. To the west of Caravalleda, a wall of bare rock again projects forward in the direction of the sea, but it has little extent. After having passed it, we immediately discovered the pleasantly situated village of Macuto; the black rocks of La Guayra, studded with batteries rising in tiers one over another; and in the misty distance, Cabo Blanco, a long promontory with conical summits, and of dazzling whiteness. Cocoa-trees border the shore, and give it, under that burning sky, an appearance of fertility.

I landed in the port of La Guayra, and the same evening made preparations for transporting my instruments to Caracas. Having been recommended not to sleep in the town, where the yellow fever had been raging only a few weeks previously, I fixed my lodging in a house on a little hill, above the village of Maiquetia, a place more exposed to fresh winds than La Guayra. I reached Caracas on the 21st of November, four days sooner than M. Bonpland, who, with the other travellers on the land journey, had suffered greatly from the rain and the inundations of the torrents, between Capaya and Curiepe.

Before proceeding further, I will here subjoin a description of La Guayra, and the extraordinary road which leads from thence to the town of Caracas, adding thereto all the observations made by M. Bonpland and myself, in an excursion to Cabo Blanco about the end of January 1800.

La Guayra is rather a roadstead than a port. The sea is constantly agitated, and ships suffer at once by the violence of the wind, the tideways, and the bad anchorage. The lading is taken in with difficulty, and the swell prevents the embarkation of mules here, as at New Barcelona and Porto Cabello. The free mulattoes and negroes, who carry the cacao on board the ships, are a class of men remarkable for muscular strength. They wade up to their waists through the water; and it is remarkable that they are never attacked by the sharks, so common in this harbour. This fact seems connected with what I have often observed within the tropics, with respect to other classes of animals which live in society, for instance monkeys and crocodiles. In the Mis-

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sions of the Orinoco, and on the banks of the river Amazon, the Indians, who catch monkeys to sell them, know very well that they can easily succeed in taming those which inhabit certain islands; while monkeys of the same species, caught on the neighbouring continent, die of terror or rage when they find themselves in the power of man. The crocodiles of one lake in the llanos are cowardly, and flee even when in the water; whilst those of another lake will attack with extreme intrepidity. It would be difficult to explain this difference of disposition and habits, by the mere aspect of the respective localities. The sharks of the port of La Guayra seem to furnish an analogous example. They are dangerous and blood-thirsty at the island opposite the coast of Caracas, at the Roques, at Bonayre, and at Curassao; while they forbear to attack persons swimming in the ports of La Guayra and Santa Martha. The natives, who like the ignorant mass of people in every country, in seeking the explanation of natural phenomena, always have recourse to the marvellous, affirm that in the ports just mentioned, a bishop gave his benediction to the sharks.

The situation of La Guayra is very singular, and can only be compared to that of Santa Cruz in Teneriffe. The chain of mountains which separates the port from the high valley of Caracas, descends almost directly into the sea; and the houses of the town are backed by a wall of steep rocks. There scarcely remains one hundred or one hundred and forty toises breadth of flat ground between the wall and the ocean. The town has six or eight thousand inhabitants, and contains only two streets, running parallel with each other east and west. It is commanded by the battery of Cerro Colorado; and its fortifications along the sea-shore are well disposed, and kept in repair. The aspect of this place has in it something solitary and gloomy; we seemed not to be on a continent, covered with vast forests, but on a rocky island, destitute of vegetation. With the exception of Cabo Blanco and the cocoa-trees of Maiquetia, no view meets the eye but that of the horizon, the sea, and the azure vault of heaven. The heat is excessive during the day, and most frequently during the night. The climate of La Guayra is justly considered to be hotter than that of Cumana, Porto Cabello, and Coro, because the sea-breeze is less felt, and the air is

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heated by the radiant caloric which the perpendicular rocks emit from the time the sun sets. The examination of the thermometric observations made during nine months at La Guayra by an eminent physician, enabled me to compare the climate of this port, with those of Cumana, of the Havannah, and of Vera Cruz. This comparison is the more interesting, as it furnishes an inexhaustible subject of conversation in the Spanish colonies, and among the mariners who frequent those latitudes. As nothing is more deceiving in such matters than the testimony of the senses, we can judge of the difference of climates only by numerical calculations.

The four places of which we have been speaking are considered as the hottest on the shores of the New World. A comparison of them may serve to confirm what we have several times observed, that it is generally the duration of a high temperature, and not the excess of heat, or its absolute quantity, which occasions the sufferings of the inhabitants of the torrid zone.

A series of thermometric observations shows, that La Guayra is one of the hottest places on the earth; that the quantity of heat which it receives in the course of a year is a little greater than that felt at Cumana; but that in the months of November, December, and January (at equal distance from the two passages of the sun through the zenith of the town), the atmosphere cools more at La Guayra. May not this cooling, much slighter than that which is felt almost at the same time at Vera Cruz and at the Havannah, be the effect of the more westerly position of La Guayra? The aërial ocean, which appears to form only one mass, is agitated by currents, the limits of which are fixed by immutable laws; and its temperature is variously modified by the configuration of the lands and seas by which it is sustained. It may be subdivided into several basins, which overflow into each other, and of which the most agitated (for instance, that over the gulf of Mexico, or between the sierra of Santa Martha and the gulf of Darien) have a powerful influence on the refrigeration and the motion of the neighbouring columns of air. The north winds sometimes cause influxes and counter-currents in the south-west part of the Caribbean Sea, which seem, during particular months, to diminish the heat as far as Terra Firma.

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At the time of my abode at La Guayra, the yellow fever, or *calentura amarilla*, had been known only two years; and the mortality it occasioned had not been very great, because the confluence of strangers on the coast of Caracas was less considerable than at the Havannah or Vera Cruz. A few individuals, even creoles and mulattoes, were sometimes carried off suddenly by certain irregular remittent fevers; which, from being complicated with bilious appearances, hæmorrhages, and other symptoms equally alarming, appeared to have some analogy with the yellow fever. The victims of these maladies were generally men employed in the hard labour of cutting wood in the forests, for instance, in the neighbourhood of the little port of Carupano, or the gulf of Santa Fé, west of Cumana. Their death often alarmed the unacclimated Europeans, in towns usually regarded as peculiarly healthy; but the seeds of the sporadic malady were propagated no farther. On the coast of Terra Firma, the real typhus of America, which is known by the names *vomito prieto* (black vomit) and yellow fever, and which must be considered as a morbid affection *sui generis*, was known only at Porto Cabello, at Carthagena, and at Santa Martha, where Gastelbondo observed and described it in 1729. The Spaniards recently disembarked, and the inhabitants of the valley of Caracas, were not then afraid to reside at La Guayra. They complained only of the oppressive heat which prevailed during a great part of the year. If they exposed themselves to the immediate action of the sun, they dreaded at most only those attacks of inflammation of the skin or eyes, which are felt everywhere in the torrid zone, and are often accompanied by a febrile affection and congestion in the head. Many individuals preferred the ardent but uniform climate of La Guayra to the cool but extremely variable climate of Caracas; and scarcely any mention was made of the insalubrity of the former port.

Since the year 1797 everything has changed. Commerce being thrown open to other vessels besides those of the mother country, seamen born in colder parts of Europe than Spain, and consequently more susceptible to the climate of the torrid zone, began to frequent La Guayra. The yellow fever broke out. North Americans, seized with the typhus, were received in the Spanish hospitals; and it was

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affirmed that they had imported the contagion, and that the disease had appeared on board a brig from Philadelphia, even before the vessel had entered the roads of La Guayra. The captain of the brig denied the fact; and asserted that, far from having introduced the malady, his crew had caught it in the port. We know from what happened at Cadiz in 1800, how difficult it is to elucidate facts, when their uncertainty serves to favour theories diametrically opposite one to another. The more enlightened inhabitants of Caracas and La Guayra, divided in opinion, like the physicians of Europe and the United States, on the question of the contagion of yellow fever, cited the instance of the American vessel; some for the purpose of proving that the typhus had come from abroad, and others, to show that it had taken birth in the country itself. Those who advocated the latter opinion, admitted that an extraordinary alteration had been caused in the constitution of the atmosphere by the overflowings of the Rio de La Guayra. This torrent, which in general is not ten inches deep, was swelled after sixty hours' rain in the mountains, in so extraordinary a manner, that it bore down trunks of trees and masses of rock of considerable size. During this flood the waters were from thirty to forty feet in breadth, and from eight to ten feet deep. It was supposed that, issuing from some subterranean basin, formed by successive infiltrations, they had flowed into the recently cleared arable lands. Many houses were carried away by the torrent; and the inundation became the more dangerous for the stores, in consequence of the gate of the town, which could alone afford an outlet to the waters, being accidentally closed. It was necessary to make a breach in the wall on the sea-side. More than thirty persons perished, and the damage was computed at half a million of piastres. The stagnant water, which infected the stores, the cellars, and the dungeons of the public prison, no doubt diffused miasms in the air, which, as a predisposing cause, may have accelerated the development of the yellow fever; but I believe that the inundation of the Rio de la Guayra was no more the primary cause, than the overflowings of the Guadalquivir, the Xenil, and the Gual-Medina, were at Seville, at Ecija, and at Malaga, the primary causes of the fatal epi-

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demics of 1800 and 1804. I examined with attention the bed of the torrent of La Guayra; and found it to consist merely of a barren soil, blocks of mica-slate, and gneiss, containing pyrites detached from the Sierra de Avila, but nothing that could have had any effect in deteriorating the purity of the air.

Since the years 1797 and 1798, at which periods there prevailed dreadful mortality at Philadelphia, St. Lucia, and St. Domingo, the yellow fever has continued its ravages at La Guayra. It has proved fatal not only to the troops newly arrived from Spain, but also to those levied in parts remote from the coasts, in the llanos between Calabozo and Uritucu, regions almost as hot as La Guayra, but favourable to health. This latter fact would seem more surprising, did we not know, that even the natives of Vera Cruz, who are not attacked with typhus in their own town, sometimes sink under it during the epidemics of the Havannah and the United States. As the black vomit finds an insurmountable barrier at the Encero (four hundred and seventy-six toises high), on the declivity of the mountains of Mexico, in the direction of Xalapa, where oaks begin to appear, and the climate begins to be cool and pleasant, so the yellow fever scarcely ever passes beyond the ridge of mountains which separates La Guayra from the valley of Caracas. This valley has been exempt from the malady for a considerable time; for we must not confound the *vomito* and the yellow fever with the irregular and bilious fevers. The Cumbre and the Cerro de Avila form a very useful rampart to the town of Caracas, the elevation of which a little exceeds that of the Encero, but of which the mean temperature is above that of Xalapa.

I have published in another work* the observations made by M. Bonpland and myself on the locality of the towns periodically subject to the visitation of yellow fever; and I shall not hazard here any new conjectures on the changes observed in the pathogenic constitution of particular localities. The more I reflect on this subject, the more mysterious appears to me all that relates to those gaseous emanations which we call so vaguely the seeds of contagion, and which are supposed to be developed by a corrupted air, destroyed

* Nouvelle Espagne, tom. ii.

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by cold, conveyed from place to place in garments, and attached to the walls of houses. How can we explain why, for the space of eighteen years prior to 1794, there was not a single instance of the *vomito* at Vera Cruz, though the concourse of unacclimated Europeans and of Mexicans from the interior, was very considerable; though sailors indulged in the same excesses with which they are still reproached; and though the town was not so clean as it has been since the year 1800?

The following is the series of pathological facts, considered in their simplest point of view. When a great number of persons, born in a cold climate, arrive at the same period in a port of the torrid zone, not particularly dreaded by navigators, the typhus of America begins to appear. Those persons have not had typhus during their passage; it appears among them only after they have landed. Is the atmospheric constitution changed? or is it that a new form of disease developes itself among individuals whose susceptibility is highly increased?

The typhus soon begins to extend its ravages among other Europeans, born in more southern countries. If propagated by contagion, it seems surprising that in the towns of the equinoctial continent it does not attach itself to certain streets; and that immediate contact* does not augment the danger, any more than seclusion diminishes it. The sick, when removed to the inland country, and especially to cooler and more elevated spots, to Xalapa, for instance, do not communicate typhus to the inhabitants of those places, either because the disease is not contagious in its nature, or because the predisposing causes are not the same as in the regions of the shore. When there is a considerable lowering of the temperature, the epidemic usually ceases, even on the spot where it first appeared. It again breaks out at the approach of the hot season, and sometimes long before; though

* In the oriental plague (another form of typhus characterised by great disorder of the lymphatic system) immediate contact is less to be feared than is generally thought. Larrey maintains that the tumified glands may be touched or cauterized without danger; but he thinks we ought not to risk putting on the clothes of persons attacked with the plague.—Mémoire sur les Maladies de l'Armée Françoise en Egypte, p. 35.

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during several months there may have been no sick person in the harbour, and no ship may have entered it.

The typhus of America appears to be confined to the shore, either because persons who bring the disease disembark there, and goods supposed to be impregnated with deleterious miasms are there accumulated; or because on the sea-side gaseous emanations of a particular nature are formed. The aspect of the places subject to the ravages of typhus seems often to exclude all idea of a local or endemical origin. It has been known to prevail in the Canaries, the Bermudas, and among the small West India Islands, in dry places formerly distinguished for the great salubrity of their climate. Examples of the propagation of the yellow fever in the inland parts of the torrid zone appear very doubtful: that malady may have been confounded with remitting bilious fevers. With respect to the temperate zone, in which the contagious character of the American typhus is more decided, the disease has unquestionably spread far from the shore, even into very elevated places, exposed to cool and dry winds, as in Spain at Medina-Sidonia, at Carlotta, and in the city of Murcia. That variety of phenomena which the same epidemic exhibits, according to the difference of climate, the union of predisposing causes, its shorter or longer duration, and the degree of its exacerbation, should render us extremely circumspect in tracing the secret causes of the American typhus. M. Bailly, who, at the time of the violent epidemics in 1802 and 1803, was chief physician to the colony of St. Domingo, and who studied that disease in the island of Cuba, the United States, and Spain, is of opinion that the typhus is very often, but not always, contagious.

Since the yellow fever has made such ravages in La Guayra, exaggerated accounts have been given of the uncleanliness in that little town as well as of Vera Cruz, and of the quays or wharfs of Philadelphia. In a place where the soil is extremely dry, destitute of vegetation, and where scarcely a few drops of water fall in the course of seven or eight months, the causes that produce what are called miasms, cannot be of very frequent occurrence. La Guayra appeared to me in general to be tolerably clean, with the exception of the quarter of the slaughter-houses. The sea-side has no beach on which the remains of fuci or molluscs are heaped up; but the neigh-

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bouring coast, which stretches eastward towards Cape Codera, and consequently to the windward of La Guayra, is extremely unhealthy. Intermitting, putrid, and bilious fevers often prevail at Macuto and at Caravalleda; and when from time to time the breeze is interrupted by a westerly wind, the little bay of Cotia sends air loaded with putrid emanations towards the coast of La Guayra, notwithstanding the rampart opposed by Cabo Blanco.

The irritability of the organs being so different in the people of the north and those of the south, it cannot be doubted, that with greater freedom of commerce, and more frequent and intimate communication between countries situated in different climates, the yellow fever will extend its ravages in the New World. It is even probable that the concurrence of so many exciting causes, and their action on individuals so differently organized, may give birth to new forms of disease and new deviations of the vital powers. This is one of the evils that inevitably attend rising civilization.

The yellow fever and the black vomit cease periodically at the Havannah and Vera Cruz, when the north winds bring the cold air of Canada towards the gulf of Mexico. But from the extreme equality of temperature which characterizes the climates of Porto Cabello, La Guayra, New Barcelona, and Cumana, it may be feared that the typhus will there become permanent, whenever, from a great influx of strangers, it has acquired a high degree of exacerbation.

Tracing the granitic coast of La Guayra westward, we find between that port (which is in fact but an ill-sheltered roadstead) and that of Porto Cabello, several indentations of the land, furnishing excellent anchorage for ships. Such are the small bay of Catia, Los Arecifes, Puerto-la-Cruz, Choroni, Sienega de Ocumare, Turiamo, Burburata, and Patanebo. All these ports, with the exception of that of Burburata, from which mules are exported to Jamaica, are now frequented only by small coasting vessels, which are there laden with provisions and cacao from the surrounding plantations. The inhabitants of Caracas are desirous to avail themselves of the anchorage of Catia, to the west of Cabo Blanco. M. Bonpland and myself examined that point of the coast during our second abode

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at La Guayra. A ravine, called the Quebrada de Tipe, descends from the table-land of Caracas towards Catia. A plan has long been in contemplation for making a cart-road through this ravine and abandoning the old road to La Guayra, which resembles the passage over St. Gothard. According to this plan, the port of Catia, equally large and secure, would supersede that of La Guayra. Unfortunately, however, all that shore, to leeward of Cabo Blanco, abounds with mangroves, and is extremely unhealthy. I ascended to the summit of the promontory, which forms Cabo Blanco, in order to observe the passage of the sun over the meridian. I wished to compare in the morning the altitudes taken with an artificial horizon and those taken with the horizon of the sea; to verify the apparent depression of the latter, by the barometrical measurement of the hill. By this method, hitherto very little employed, on reducing the heights of the sun to the same time, a reflecting instrument may be used like an instrument furnished with a level. I found the latitude of the cape to be 10° 36′ 45″; I could only make use of the angles which gave the image of the sun reflected on a plane glass; the horizon of the sea was very misty, and the windings of the coast prevented me from taking the height of the sun on that horizon.

The environs of Cabo Blanco are not uninteresting for the study of rocks. The gneiss here passes into the state of mica-slate,* and contains, along the sea-coast, layers of schistose chlorite.† In this latter I found garnets and magnetical sand. On the road to Catia we see the chloritic schist passing into hornblende schist.‡ All these formations are found together in the primitive mountains of the old world, especially in the north of Europe. The sea at the foot of Cabo Blanco throws up on the beach rolled fragments of a rock, which is a granular mixture of hornblende and lamellar feldspar. It is what is rather vaguely called *primitive grunstein*. In it we can recognize traces of quartz and pyrites. Submarine rocks probably exist near the coast, which furnish these very hard masses. I have

* Glimmerschiefer. † Chloritschiefer.

‡ Hornblendschiefer.

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compared them in my journal to the *paterlestein* of Fichtelberg, in Franconia, which is also a diabase, but so fusible, that glass buttons are made of it, which are employed in the slave-trade on the coast of Guinea. I believed at first, according to the analogy of the phenomena furnished by the mountains of Franconia, that the presence of these hornblende masses with crystals of common (uncompact) feldspar indicated the proximity of transition rocks; but in the high valley of Caracas, near Antimano, balls of the same diabase fill a vein crossing the mica-slate. On the western declivity of the hill of Cabo Blanco, the gneiss is covered with a formation of sandstone, or conglomerate, extremely recent. This sandstone combines angular fragments of gneiss, quartz, and chlorite, magnetical sand, madrepores, and petrified bivalve shells. Is this formation of the same date as that of Punta Araya and Cumana?

Scarcely any part of the coast has so burning a climate as the environs of Cabo Blanco. We suffered much from the heat, augmented by the reverberation of a barren and dusty soil; but without feeling any bad consequences from the effects of insolation. The powerful action of the sun on the cerebral functions is extremely dreaded at La Guayra, especially at the period when the yellow fever begins to be felt. Being one day on the terrace of the house, observing at noon the difference of the thermometer in the sun and in the shade, a man approached me holding in his hand a potion, which he conjured me to swallow. He was a physician, who from his window, had observed me bareheaded, and exposed to the rays of the sun. He assured me, that, being a native of a very northern climate, I should infallibly, after the imprudence I had committed, be attacked with the yellow fever that very evening, if I refused to take the remedy against it. I was not alarmed by this prediction, however serious, believing myself to have been long acclimated; but I could not resist yielding to entreaties, prompted by such benevolent feelings. I swallowed the dose; and the physician doubtless counted me among the number of those he had saved.

The road leading from the port to Caracas (the capital of a government of near 900,000 inhabitants) resembles, as I have already observed, the passage over the Alps,

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the road of St. Gothard, and of the Great St. Bernard. Taking the level of the road had never been attempted before my arrival in the province of Venezuela. No precise idea had even been formed of the elevation of the valley of Caracas. It had indeed been long observed, that the descent was much less from La Cumbre and Las Vueltas (the latter is the culminating point of the road towards the Pastora at the entrance of the valley of Caracas), than towards the port of La Guayra; but the mountain of Avila having a very considerable bulk, the eye cannot discern simultaneously the points to be compared. It is even impossible to form a precise idea of the elevation of Caracas, from the climate of the valley, where the atmosphere is cooled by the descending currents of air, and by the mists, which envelope the lofty summit of the Silla during a great part of the year.

When in the season of the great heats we breathe the burning atmosphere of La Guayra, and turn our eyes towards the mountains, it seems scarcely possible that, at the distance of five or six thousand toises, a population of forty thousand individuals assembled in a narrow valley, enjoys the coolness of spring, a temperature which at night descends to 12° of the centesimal thermometer. This near approach of different climates is common in the Cordillera of the Andes; but everywhere, at Mexico, at Quito, in Peru, and in New Granada, it is only after a long journey into the interior, either across plains or along rivers, that we reach the great cities, which are the central points of civilization. The height of Caracas is but a third of that of Mexico, Quito, and Santa Fé de Bogotá; yet of all the capitals of Spanish America which enjoy a cool and delicious climate in the midst of the torrid zone, Caracas is nearest to the coast. What a privilege for a city to possess a seaport at three leagues distance, and to be situated among mountains, on a table-land, which would produce wheat, if the cultivation of the coffee-tree were not preferred!

The road from La Guayra to the valley of Caracas is infinitely finer than the road from Honda to Santa Fé, or that from Guayaquil to Quito. It is kept in better order than the old road, which led from the port of Vera Cruz to Perote, on the eastern declivity of the mountains of New

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Spain. With good mules it takes but three hours to go from the port of La Guayra to Caracas; and only two hours to return. With loaded mules, or on foot, the journey is from four to five hours. The road runs along a ridge of rocks extremely steep, and after passing the stations bearing respectively the names of Torre Quemada, Curucuti, and Salto, we arrive at a large inn (La Venta) built at six hundred toises above the level of the sea. The name Torre Quemada, or Burnt Tower, indicates the sensation that is felt in descending towards La Guayra. A suffocating heat is reflected from the walls of rock, and especially from the barren plains on which the traveller looks down. On this road, as on that from Vera Cruz to Mexico, and wherever on a rapid declivity the climate changes, the increase of muscular strength and the sensation of well-being, which we experience as we advance into strata of cooler air, have always appeared to me less striking than the feeling of languor and debility which pervades the frame, when we descend towards the burning plains of the coast. But such is the organization of man; and even in the moral world, we are less soothed by that which ameliorates our condition than annoyed by a new sensation of discomfort.

From Curucuti to Salto the ascent is somewhat less laborious. The sinuosities of the way render the declivity easier, as in the old road over Mont Cenis. The Salto (or Leap) is a crevice, which is crossed by a draw-bridge. Fortifications crown the summit of the mountain. At La Venta the thermometer at noon stood at 19·3°, when at La Guayra it kept up at the same hour at 26·2°. La Venta enjoys some celebrity in Europe and in the United States, for the beauty of its surrounding scenery. When the clouds permit, this spot affords a magnificent view of the sea, and the neighbouring coasts. An horizon of more than twenty-two leagues radius is visible; the white and barren shore reflects a dazzling mass of light; and the spectator beholds at his feet Cabo Blanco, the village of Maiquetia with its cocoa-trees, La Guayra, and the vessels in the port. But I found this view far more extraordinary, when the sky was not serene, and when trains of clouds, strongly illumined on their upper surface, seemed projected like floating islands on the ocean. Strata of vapour, hovering at different

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heights, formed intermediary spaces between the eye and the lower regions. By an illusion easily explained, they enlarged the scene, and rendered it more majestic. Trees and dwellings appeared at intervals through the openings, which were left by the clouds when driven on by the winds, and rolling over one another. Objects then appear at a greater depth than when seen through a pure and uniformly serene air. On the declivity of the mountains of Mexico, at the same height (between Las Trancas and Xalapa), the sea is twelve leagues distant, and the view of the coast is confused; while on the road from La Guayra to Caracas we command the plains (the *tierra caliente*), as from the top of a tower. How extraordinary must be the impression created by this prospect on natives of the inland parts of the country, who behold the sea and ships for the first time from this point.

I determined by direct observations the latitude of La Venta, that I might be enabled to give a more precise idea of the distance of the coasts. The latitude is 10° 33′ 9″. Its longitude appeared to me by the chronometer, nearly 2′ 47″ west of the town of Caracas. I found the dip of the needle at this height to be 41·75°, and the intensity of the magnetic forces equal to two hundred and thirty-four oscillations. From the Venta, called also La Venta Grande, to distinguish it from three or four small inns formerly established along the road, but now destroyed, there is still an ascent of one hundred and fifty toises to Guayavo. This is nearly the most lofty point of the road.

Whether we gaze on the distant horizon of the sea, or turn our eyes south-eastward, in the direction of the serrated ridge of rocks, which seems to unite the Cumbre and the Silla, though separated from them by the ravine (quebrada) of Tocume, everywhere we admire the grand character of the landscape. From Guayavo we proceed for half an hour over a smooth table-land, covered with alpine plants. This part of the way, on account of its windings, is called Las Vueltas. We find a little higher up the barracks or magazines of flour, which were constructed in a spot of cool temperature by the Guipuzcoa Company, when they had the exclusive monopoly of the trade of Caracas, and supplied that place with provision. On the road to Las Vueltas we see for the first time

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the capital, situated three hundred toises below, in a valley luxuriantly planted with coffee and European fruit-trees. Travellers are accustomed to halt near a fine spring, known by the name of Fuente de Sanchorquiz, which flows down from the Sierra on sloping strata of gneiss. I found its temperature 16·4°; which, for an elevation of seven hundred and twenty-six toises, is considerably cool, and it would appear much cooler to those who drink its limped water, if, instead of gushing out between La Cumbre and the temperate valley of Caracas, it were found on the descent towards La Guayra. But at this descent on the northern side of the mountain, the rock, by an uncommon exception in this country, does not dip to north-west, but to south-east, which prevents the subterranean waters from forming springs there.

We continued to descend from the small ravine of Sanchorquiz to la Cruz de la Guayra, a cross erected on an open spot, six hundred and thirty-two toises high, and thence (entering by the custom-house and the quarter of the Pastora) to the city of Caracas. On the south side of the mountain of Avila, the gneiss presents several geognostical phenomena worthy of the attention of travellers. It is traversed by veins of quartz, containing cannulated and often articulated prisms of rutile titanite two or three lines in diameter. In the fissures of the quartz we find, on breaking it, very thin crystals, which crossing each other form a kind of network. Sometimes the red schorl occurs only in dendritic crystals of a bright red.* The gneiss of the valley of Caracas is characterized by the red and green garnets it contains; they however disappear when the rock passes into mica-slate. This same phenomenon has been remarked by Von Buch in Sweden; but in the temperate parts of Europe garnets are in general contained in serpentine and mica-slates, not in gneiss. In the walls which enclose the gardens of Caracas, constructed partly of fragments of gneiss, we find garnets of a very fine red, a little transparent, and very difficult to detach. The gneiss near the Cross of La Guayra, half a league from Caracas, presented also vestiges of

* Especially below the Cross of La Guayra, at 594 toises of absolute elevation.

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azure copper-ore* disseminated in veins of quartz, and small strata of plumbago (black lead), or earthy carburetted iron. This last is found in pretty large masses, and sometimes mingled with sparry iron-ore, in the ravine of Tocume, to the west of the Silla.

Between the spring of Sanchorquiz and the Cross of La Guayra, as well as still higher up, the gneiss contains considerable beds of saccharoidal bluish-grey primitive limestone, coarse-grained, containing mica, and traversed by veins of white calcareous spar. The mica, with large folia, lies in the direction of the dip of the strata. I found in the primitive limestone a great many crystallized pyrites, and rhomboidal fragments of sparry iron-ore of Isabella yellow. I endeavoured, but without success, to find tremolite,† which in the Fitchelberg, in Franconia, is common in the primitive limestone without dolomite. In Europe beds of primitive limestone are generally observed in the mica-slates; but we find also saccharoidal limestone in gneiss of the most ancient formation, in Sweden near Upsala, in Saxony near Burkersdorf, and in the Alps in the road over the Simplon. These situations are analogous to that of Caracas. The phenomena of geognosy, particularly those which are connected with the stratification of rocks, and their grouping, are never solitary; but are found the same in both hemispheres. I was the more struck with these relations, and this identity of formations, as, at the time of my journey in these countries, mineralogists were unacquainted with the name of a single rock of Venezuela, New Grenada, and the Cordilleras of Quito.

* Blue carbonate of copper.

† Grammatite of Haüy. The primitive limestone above the spring of Sanchorquiz, is directed, as the gneiss in that place, hor. 5·2, and dips 45° north; but the general direction of the gneiss is, in the Cerro de Avila, hor. 3·4 with 60° of dip N.W. Exceptions merely local are observed in a small space of ground near the Cross of La Guayra (hor. 6·2, dip 8° N.); and higher up, opposite the Quebrada of Tipe (hor. 12, dip 50° W.).

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Chapter XII.

General View of the Provinces of Venezuela.—Diversity of their Interests. —City and Valley of Caracas.—Climate.

In all those parts of Spanish America in which civilization did not exist to a certain degree before the Conquest (as it did in Mexico, Guatimala, Quito, and Peru), it has advanced from the coasts to the interior of the country, following sometimes the valley of a great river, sometimes a chain of mountains, affording a temperate climate. Concentrated at once in different points, it has spread as if by diverging rays. The union into provinces and kingdoms was effected on the first immediate contact between civilized parts, or at least those subject to permanent and regular government. Lands deserted, or inhabited by savage tribes, now surround the countries which European civilization has subdued. They divide its conquests like arms of the sea difficult to be passed, and neighbouring states are often connected with each other only by slips of cultivated land. It is less difficult to acquire a knowledge of the configuration of coasts washed by the ocean, than of the sinuosities of that interior shore, on which barbarism and civilization, impenetrable forests and cultivated land, touch and bound each other. From not having reflected on the early state of society in the New World, geographers have often made their maps incorrect, by marking the different parts of the Spanish and Portuguese colonies, as though they were contiguous at every point in the interior. The local knowledge which I obtained respecting these boundaries, enables me to fix the extent of the great territorial divisions with some certainty, to compare the wild and inhabited parts, and to appreciate the degree of political influence exercised by certain towns of America, as centres of power and of commerce.

Caracas is the capital of a country nearly twice as large as Peru, and now little inferior in extent to the kingdom of New Grenada.* This country which the Spanish govern-

* The Capitania-General of Caracas contains near 48,000 square leagues (twenty-five to a degree). Peru, since La Paz, Potosi, Charcas,

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ment designates by the name of Capitania-General de Caracas,* or of the united provinces of Venezuela, has nearly a million of inhabitants, among whom are sixty thousand slaves. It comprises, along the coasts, New Andalusia, or the province of Cumana (with the island of Margareta),† Barcelona, Venezuela or Caracas, Coro, and Maracaybo; in the interior, the provinces of Varinas and Guiana; the former situated on the rivers of Santo Domingo and the Apure, the latter stretching along the Orinoco, the Casiquiare, the Atabapo, and the Rio Negro. In a general view of the seven united provinces of Terra Firma, we perceive that they form three distinct zones, extending from east to west.

We find, first, cultivated land along the sea-shore, and near the chain of the mountains on the coast; next, savannahs or pasturages; and finally, beyond the Orinoco, a third zone, that of the forests, into which we can penetrate only by the rivers which traverse them. If the native inhabitants of the forests lived entirely on the produce of the chase, like those of the Missouri, we might say that the three zones into which we have divided the territory of Venezuela, picture the three states of human society; the life of the wild hunter, in the woods of the Orinoco; pastoral life, in the savannahs or llanos; and the agricultural state, in the high valleys, and at the foot of the mountains on the coast. Missionary monks and some few soldiers occupy here, as throughout all Spanish America, advanced posts along the frontiers of Brazil. In this first zone are felt the preponderance of force, and the abuse of power, which is its necessary consequence. The natives carry on civil war, and sometimes devour one another. The monks endeavour to augment the number of little villages of their Missions, by taking advantage of the dissensions of the natives. The mili-

and Santa Cruz de la Sierra, have been separated from it, contains only 30,000. New Grenada, including the province of Quito, contains 65,000. *Reinos*, *Capitanias-Generales*, *Presidencias*, *Goviernos*, and *Provincias*, are the names by which Spain formerly distinguished her transmarine possessions, or, as they were called, 'Dominios de Ultramar' (Dominions beyond Sea.)

* The captain-general of Caracas has the title of "Capitan-General de las Provincias de Venezuela y Ciudad de Caracas."

† This island, near the coast of Cumana, forms a separate governo, depending immediately on the captain-general of Caracas.

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tary live in a state of hostility to the monks, whom they were intended to protect. Everything presents a melancholy picture of misery and privation. We shall soon have occasion to examine more closely that state of man, which is vaunted as a state of nature, by those who inhabit towns. In the second region, in the plains and pasture-grounds, food is extremely abundant, but has little variety. Although more advanced in civilization, the people beyond the circle of some scattered towns are not less isolated from one another. At sight of their dwellings, partly covered with skins and leather, it might be supposed that, far from being fixed, they are scarcely encamped in those vast plains which extend to the horizon. Agriculture, which alone consolidates the bases, and strengthens the bonds of society, occupies the third zone, the shore, and especially the hot and temperate valleys among the mountains near the sea.

It may be objected, that in other parts of Spanish and Portuguese America, wherever we can trace the progressive development of civilization, we find the three ages of society combined. But it must be remembered that the position of the three zones, that of the forests, the pastures, and the cultivated land, is not everywhere the same, and that it is nowhere so regular as in Venezuela. It is not always from the coast to the interior, that population, commercial industry, and intellectual improvement, diminish. In Mexico, Peru, and Quito, the table-lands and central mountains possess the greatest number of cultivators, the most numerous towns situated near to each other, and the most ancient institutions. We even find, that, in the kingdom of Buenos Ayres, the region of pasturage, known by the name of the Pampas, lies between the isolated part of Buenos Ayres and the great mass of Indian cultivators, who inhabit the Cordilleras of Charcas, La Paz, and Potosi. This circumstance gives birth to a diversity of interests, in the same country, between the people of the interior and those who inhabit the coasts.

To form an accurate idea of those vast provinces which have been governed for ages, almost like separate states, by viceroys and captains-general, we must fix our attention at once on several points. We must distinguish the parts of Spanish America opposite to Asia from those on the shores

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of the Atlantic; we must ascertain where the greater portion of the population is placed; whether near the coast, or concentrated in the interior, on the cold and temperate table-lands of the Cordilleras. We must verify the numerical proportions between the natives and other castes; search into the origin of the European families, and examine to what race, in each part of the colonies, belongs the greater number of whites. The Andalusian-Canarians of Venezuela, the Mountaineers* and the Biscayans of Mexico, the Catalonians of Buenos Ayres, differ essentially in their aptitude for agriculture, for the mechanical arts, for commerce, and for all objects connected with intellectual development. Each of those races has preserved, in the New as in the Old World, the shades that constitute its national physiognomy; its asperity or mildness of character; its freedom from sordid feelings, or its excessive love of gain; its social hospitality, or its taste for solitude. In the countries where the population is for the most part composed of Indians and mixed races, the difference between the Europeans and their descendants cannot indeed be so strongly marked, as that which existed anciently in the colonies of Ionian and Doric origin. The Spaniards transplanted to the torrid zone, estranged from the habits of their mother-country, must have felt more sensible changes than the Greeks settled on the coasts of Asia Minor, and of Italy, where the climates differ so little from those of Athens and Corinth. It cannot be denied that the character of the Spanish Americans has been variously modified by the physical nature of the country; the isolated sites of the capitals on the table-lands or in the vicinity of the coasts; the agricultural life; the labour of the mines, and the habit of commercial speculation: but in the inhabitants of Caracas, Santa Fé, Quito, and Buenos Ayres, we recognize everywhere something which belongs to the race and the filiation of the people.

If we examine the state of the Capitania-General of Caracas, according to the principles here laid down, we perceive that agricultural industry, the great mass of population, the numerous towns, and everything connected with advanced civilization, are found near the coast. This coast

* *Montañeses.* The inhabitants of the mountains of Santander are called by this name in Spain.

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extends along a space of two hundred leagues. It is washed by the Caribbean Sea, a sort of Mediterranean, on the shores of which almost all the nations of Europe have founded colonies; which communicates at several points with the Atlantic; and which has had a considerable influence on the progress of knowledge in the eastern part of equinoctial America, from the time of the Conquest. The kingdoms of New Grenada and Mexico have no connection with foreign colonies, and through them with the nations of Europe, except by the ports of Carthagena, of Santa Martha, of Vera Cruz, and of Campeachy. These vast countries, from the nature of their coasts, and the isolation of their inhabitants on the back of the Cordilleras, have few points of contact with foreign lands. The gulf of Mexico also is but little frequented during a part of the year, on account of the danger of gales of wind from the north. The coasts of Venezuela, on the contrary, from their extent, their eastward direction, the number of their ports, and the safety of their anchorage at different seasons, possess all the advantages of the Caribbean Sea. The communications with the larger islands, and even with those situated to windward, can nowhere be more frequent than from the ports of Cumana, Barcelona, La Guayra, Porto-Cabello, Coro, and Maracaybo. Can we wonder that this facility of commercial intercourse with the inhabitants of free America, and the agitated nations of Europe, should in the provinces united under the Capitania-General of Venezuela, have augmented opulence, knowledge, and that restless desire of a local government, which is blended with the love of liberty and republican forms?

The copper-coloured natives, or Indians, constitute an important mass of the agricultural population only in those places where the Spaniards, at the time of the Conquest, found regular governments, social communities, and ancient and very complicated institutions; as, for example, in New Spain, south of Durango; and in Peru, from Cuzco to Potosi. In the Capitania-General of Caracas, the Indian population is inconsiderable, at least beyond the Missions and in the cultivated zone. Even in times of great political excitement, the natives do not inspire any apprehension in the whites or the mixed castes. Computing, in 1800, the

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total population of the seven united provinces at nine hundred thousand souls, it appeared to me that the Indians made only one-ninth; while at Mexico they form nearly one half of the inhabitants.

Considering the Caribbean Sea, of which the gulf of Mexico makes a part, as an interior sea with several mouths, it is important to fix our attention on the political relations arising out of this singular configuration of the New Continent, between countries placed around the same basin. Notwithstanding the isolated state in which most of the mother-countries endeavour to hold their colonies, the agitations that take place are not the less communicated from one to the other. The elements of discord are everywhere the same; and, as if by instinct, an understanding is established between men of the same colour, although separated by difference of language, and inhabiting opposite coasts. That American Mediterranean formed by the shores of Venezuela, New Grenada, Mexico, the United States, and the West India Islands, counts upon its borders near a million and a half of free and enslaved blacks; but so unequally distributed, that there are very few to the south, and scarcely any in the regions of the west. Their great accumulation is on the northern and eastern coasts, which may be said to be the African part of the interior basin. The commotions which since 1792 have broken out in St. Domingo, have naturally been propagated to the coasts of Venezuela. So long as Spain possessed those fine colonies in tranquillity, the little insurrections of the slaves were easily repressed; but when a struggle of another kind, that for independence, began, the blacks by their menacing position excited alternately the apprehensions of the opposite parties; and the gradual or instantaneous abolition of slavery has been proclaimed in different regions of Spanish America, less from motives of justice and humanity, than to secure the aid of an intrepid race of men, habituated to privation, and fighting for their own cause. I found in the narrative of the voyage of Girolamo Benzoni, a curious passage, which proves that the apprehensions caused by the increase of the black population are of very old date. These apprehensions will cease only where governments shall second by laws the progressive reforms which refinement of manners, opinion,

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and religious sentiment, introduce into domestic slavery. "The negroes," says Benzoni, "multiply so much at St. Domingo, that in 1545, when I was in Terra Firma [on the coast of Caracas], I saw many Spaniards who had no doubt that the island would shortly be the property of the blacks."* It was reserved for our age to see this prediction accomplished; and a European colony of America transform itself into an African state.

The sixty thousand slaves which the seven united provinces of Venezuela are computed to contain, are so unequally divided, that in the province of Caracas alone there are nearly forty thousand, one-fifth of whom are mulattoes; in Maracaybo, there are ten or twelve thousand; but in Cumana and Barcelona, scarcely six thousand. To judge of the influence which the slaves and men of colour exercise on the public tranquility, it is not enough to know their number, we must consider their accumulation at certain points, and their manner of life, as cultivators or inhabitants of towns. In the province of Venezuela, the slaves are assembled together on a space of no great extent, between the coast, and a line which passes (at twelve leagues from the coast) through Panaquire, Yare, Sabana de Ocumare, Villa de Cura, and Nirgua. The llanos or vast plains of Calaboso, San Carlos, Guanare, and Barquecimeto, contain only four or five thousand slaves, who are scattered among the farms, and employed in the care of cattle. The number of free men is very considerable; the Spanish laws and customs being favourable to affranchisement. A master cannot refuse liberty to a slave who offers him the sum of three hundred piastres, even though the slave may have cost double that price, on account of his industry, or a particular aptitude for the trade he practises. Instances of persons who voluntarily bestow liberty on a certain number of their slaves, are more common in the

* "Vi sono molti Spagnuoli che tengono per cosa certa, che quest' isola (San Dominico) in breve tempo sara posseduta da questi Mori di Guinea." (Benzoni, Istoria del Mondo Nuovo, ediz. 2da, 1672, p. 65.) The author, who is not very scrupulous in the adoption of statistical facts, believes that in his time there were at St. Domingo seven thousand fugitive negroes (Mori cimaroni), with whom Don Luis Columbus made a treaty of peace and friendship.

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province of Venezuela than in any other place. A short time before we visited the fertile valleys of Aragua and the lake of Valencia, a lady who inhabited the great village of Victoria, ordered her children, on her death-bed, to give liberty to all her slaves, thirty in number. I feel pleasure in recording facts that do honour to the character of a people from whom M. Bonpland and myself received so many marks of kindness.

If we compare the seven united provinces of Venezuela with the kingdom of Mexico and the island of Cuba, we shall succeed in finding the approximate number of white Creoles, and even of Europeans. The white Creoles, whom I may call Hispano-Americans,* form in Mexico nearly a fifth, and in the island of Cuba, according to the very accurate enumeration of 1801, a third of the whole population. When we reflect that the kingdom of Mexico contains two millions and a half of natives of the copper-coloured race; when we consider the state of the coasts bordering on the Pacific, and the small number of whites in the intendencias of Puebla and Oaxaca, compared with the natives, we cannot doubt that the province of Venezuela at least, if not the capitania-general, has a greater proportion than that of one to five. The island of Cuba,† in which the whites are even more numerous than in Chile, may furnish us with a limiting number, that is to say, the maximum which may be supposed in the capitania-general of Caracas. I believe we must stop at at two hundred, or two hundred and ten thousand Hispano-Americans, in a total population of nine hundred thousand souls. The number of Europeans included in the white race (not comprehending the troops sent from the mother-country) does not exceed twelve or fifteen thousand. It certainly is not greater at Mexico than sixty thousand; and I find by several statements, that, if we estimate the whole of the Spanish colonies at fourteen or

* In imitation of the word Anglo-American, adapted in all the languages of Europe. In the Spanish colonies, the whites born in America are called *Spaniards;* and the real Spaniards, those born in the mother-country, are called *Europeans*, *Gachupins*, or *Chapetons*.

† I do not mention the kingdom of Buenos Ayres, where, among a million of inhabitants, the whites are extremely numerous in parts near the coast; while the table-lands, or provinces of the sierra, are almost entirely peopled with natives.

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fifteen millions of inhabitants, there are in that number at most three millions of Creole whites, and two hundred thousand Europeans.

When Tupac-Amaru, who believed himself to be the legitimate heir to the empire of the Incas, made the conquest of several provinces of Upper Peru, in 1781, at the head of forty thousand Indian mountaineers, all the whites were filled with alarm. The Hispano-Americans felt, like the Spaniards born in Europe, that the contest was between the copper-coloured race and the whites; between barbarism and civilization. Tupac-Amaru, who himself was not destitute of intellectual cultivation, began with flattering the creoles and the European clergy; but soon, impelled by events, and by the spirit of vengeance that inspired his nephew, Andres Condorcanqui, he changed his plan. A rising for independence became a cruel war between the different castes; the whites were victorious, and excited by a feeling of common interest, from that period they kept watchful attention on the proportions existing in the different provinces between their numbers and those of the Indians. It was reserved for our times to see the whites direct this attention towards themselves; and examine, from motives of distrust, the elements of which their own caste is composed. Every enterprise in favour of independence and liberty puts the national or American party in opposition to the men of the mother-country. When I arrived at Caracas, the latter had just escaped from the danger with which they thought they were menaced by the insurrection projected by España. The consequences of that bold attempt were the more deplorable, because, instead of investigating the real causes of the popular discontent, it was thought that the mother-country would be saved by employing vigorous measures. At present, the commotions which have arisen throughout the country, from the banks of the Rio de la Plata to New Mexico, an extent of fourteen hundred leagues, have divided men of a common origin.

The Indian population in the united provinces of Venezuela is not considerable, and is but recently civilized. All the towns were founded by the Spanish conquerors, who could not carry out, as in Mexico and Peru, the old civilization of the natives. Caracas, Maracaybo, Cumana, and

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Coro, have nothing Indian but their names. Compared with the three capitals of equinoctial America,* situated on the mountains, and enjoying a temperate climate, Caracas is the least elevated. It is not a central point of commerce, like Mexico, Santa Fé de Bogotá, and Quito. Each of the seven provinces united in one capitania-general has a port, by which its produce is exported. It is sufficient to consider the position of the provinces, their respective degree of intercourse with the Windward Islands, the direction of the mountains, and the course of the great rivers, to perceive that Caracas can never exercise any powerful political influence over the territories of which it is the capital. The Apure, the Meta, and the Orinoco, running from west to east, receive all the streams of the llanos, or the region of pasturage. St. Thomas de la Guiana will necessarily, at some future day, be a trading-place of high importance, especially when the flour of New Grenada, embarked above the confluence of the Rio Negro and the Umadea, and descending by the Meta and Orinoco, shall be preferred at Caracas and Guiana to the flour of New England. It is a great advantage to the provinces of Venezuela, that their territorial wealth is not directed to one point, like that of Mexico and New Grenada, which flows to Vera Cruz and Carthagena; but that they possess a great number of towns equally well peopled, and forming various centres of commerce and civilization.

The city of Caracas is seated at the entrance of the plain of Chacao, which extends three leagues eastward, in the direction of Caurimare and the Cuesta de Auyamas, and is two leagues and a half in breadth. This plain, through which runs the Rio Guayra, is at the elevation of four hundred and fourteen toises above the level of the sea. The ground on which the city of Caracas is built is uneven, and has a steep slope from N.N.W. to S.S.E. To form an accurate idea of the situation of Caracas, we must bear in mind the general direction of the mountains of the coast, and the great longitudinal valleys by which they are traversed. The

* Mexico, Santa Fé de Bogotá, and Quito. The elevation of the site of the capital of Guatimala is still unknown. Judging from the vegetation, we may infer that it is less than 500 toises.

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Rio Guayra rises in the group of primitive mountains of Higuerote, which separates the valley of Caracas from that of Aragua. It is formed near Las Ajuntas, by the junction of the little rivers of San Pedro and Macarao, and runs first eastward as far as the Cuesta of Auyamas, and then southward, uniting its waters with those of the Rio Tuy, below Yare. The Rio Tuy is the only considerable river in the northern and mountainous part of the province.

The river flows in a direct course from west to east, the distance of thirty leagues, and it is navigable along more than three quarters of that distance. By barometrical measurements I found the slope of the Tuy along this length, from the plantation of Manterola* to its mouth, east of Cape Codera, to be two hundred and ninety-five toises. This river forms in the chain of the coast a kind of longitudinal valley, while the waters of the llanos, or of five-sixths of the province of Caracas, follow the slope of the land southward, and join the Orinoco. This hydrographic sketch may throw some light on the natural tendency of the inhabitants of each particular province, to export their productions by different roads.

The valleys of Caracas and of the Tuy run parallel for a considerable length. They are separated by a mountainous tract, which is crossed in going from Caracas to the high savannahs of Ocumare, passing by La Valle and Salamanca. These savannahs themselves are beyond the Tuy; and the valley of the Tuy being a great deal lower than that of Caracas, the descent is almost constantly from north to south. As Cape Codera, the Silla, the Cerro de Avila between Caracas and La Guayra, and the mountains of Mariara, constitute the most northern and elevated range of the coast chain; so the mountains of Panaquire, Ocumare, Guiripa, and of the Villa de Cura, form the most southern range. The general direction of the strata composing this vast chain of the coast is from south-east to north-west; and the dip is generally towards north-west: hence it follows, that the direction of the primitive strata is independent of that of the whole chain. It is extremely remarkable,

* At the foot of the high mountain of Cocuyza, 3 east from Victoria.

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tracing this chain* from Porto Cabello as far as Maniquarez and Macanao, in the island of Margareta, to find, from west to east, first granite, then gneiss, mica-slate, and primitive schist; and finally, compact limestone, gypsum, and conglomerates containing sea-shells.

It is to be regretted that the town of Caracas was not built farther to the east, below the entrance of the Anauco into the Guayra; on that spot near Chacao, where the valley widens into an extensive plain, which seems to have been levelled by the waters. Diego de Losada, when he founded† the town, followed no doubt the traces of the first establishment made by Faxardo. At that time, the Spaniards, attracted by the high repute of the two gold mines of Los Teques and Baruta, were not yet masters of the whole valley, and preferred remaining near the road leading to the coast. The town of Quito is also built in the narrowest and most uneven part of a valley, between two fine plains, Turupamba and Rumipamba.

The descent is uninterrupted from the custom-house of the Pastora, by the square of Trinidad and the Plaza Mayor, to Santa Rosalia, and the Rio Guayra. This declivity of the ground does not prevent carriages from going about the town; but the inhabitants make little use of them. Three small rivers, descending from the mountains, the Anauco, the Catuche, and the Caraguata, intersect the town, running from north to south. Their banks are very high; and, with the dried-up ravines which join them, furrowing the ground, they remind the travèller of the famous Guaicos of Quito, only on a smaller scale. The water used for drinking at Caracas is that of the Rio Catuche; but the richer class of the inhabitants have their water brought from La Valle, a village a league distant on the south. This water and that of Gamboa are considered very salubrious, because they flow over the roots of sarsaparilla.‡ I could not discover in

* I have spoken, in the preceding chapter, p. 374, of the interruption in the chain of the coast to the east of Cape Codera.

† The foundation of Santiago de Leon de Caracas dates from 1567, and is posterior to that of Cumana, Coro, Nueva Barcelona, and Caravalleda, or El Collado.

‡ Throughout America water is supposed to share the properties of those plants under the shade of which it flows. Thus, at the Straits

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them any aromatic or extractive matter. The water of the valley does not contain lime, but a little more carbonic acid than the water of the Anauco. The new bridge over this river is a handsome structure. Caracas contains eight churches, five convents, and a theatre capable of holding fifteen or eighteen hundred persons. When I was there, the pit, in which the seats of the men are apart from those of the women, was uncovered. By this means the spectators could either look at the actors or gaze at the stars. As the misty weather made me lose a great many observations of Jupiter's satellites, I was able to ascertain, as I sat in a box in the theatre, whether the planet would be visible that night. The streets of Caracas are wide and straight, and they cross each other at right angles, as in all the towns built by the Spaniards in America. The houses are spacious, and higher than they ought to be in a country subject to earthquakes. In 1800, the two squares of Alta Gracia and San Francisco presented a very agreeable aspect; I say in the year 1800, because the terrible shocks of the 26th of March, 1812, almost destroyed the whole city, which is only now slowly rising from its ruins. The quarter of Trinidad, in which I resided, was destroyed as completely as if a mine had been sprung beneath it.

The small extent of the valley, and the proximity of the high mountains of Avila and the Silla, give a gloomy and stern character to the scenery of Caracas; particularly in that part of the year when the coolest temperature prevails, viz., in the months of November and December. The mornings are then very fine; and on a clear and serene sky we could perceive the two domes or rounded pyramids of the Silla, and the craggy ridge of the Cerro de Avila. But towards evening the atmosphere thickens; the mountains are overhung with clouds; streams of vapour cling to their evergreen slopes, and seem to divide them into zones one above another. These zones are gradually blended together; the cold air which descends from the Silla, accumulates in the valley, and condenses the light vapours into large fleecy clouds. These often descend below the Cross of La Guayra, and advance, gliding on the soil, in the direction of the Pastora

of Magellan, that water is much praised which comes in contact with the roots of the Canella winterana.

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of Caracas, and the adjacent quarter of Trinidad. Beneath this misty sky, I could scarcely imagine myself to be in one of the temperate valleys of the torrid zone; but rather in the north of Germany, among the pines and the larches that cover the mountains of the Hartz.

But this gloomy aspect, this contrast between the clearness of morning and the cloudy sky of evening, is not observable in the midst of summer. The nights of June and July are clear and delicious. The atmosphere then preserves, almost without interruption, the purity and transparency peculiar to the table-lands and elevated valleys of these regions in calm weather, as long as the winds do not mingle together strata of air of unequal temperature. That is the season for enjoying the beauty of the landscape, which, however, I saw clearly illumined only during a few days at the end of January. The two rounded summits of the Silla are seen at Caracas, almost under the same angles of elevation* as the peak of Teneriffe at the port of Orotava. The first half of the mountain is covered with short grass; then succeeds the zone of evergreen trees, reflecting a purple light at the season when the befaria, the alpine rose-tree† of equinoctial America, is in blossom. The rocky masses rise above this wooded zone in the form of domes. Being destitute of vegetation, they increase by the nakedness of their surface the apparent height of a mountain which, in the temperate parts of Europe, would scarcely rise to the limit of perpetual snow. The cultivated region of the valley, and the gay plains of Chacao, Petare, and La Vega, form an agreeable contrast to the imposing aspect of the Silla, and the great irregularities of the ground on the north of the town.

The climate of Caracas has often been called a perpetual spring. The same sort of climate exists everywhere, halfway up the Cordilleras of equinoctial America, between four hundred and nine hundred toises of elevation, except in places where the great breadth of the valleys, combined with an arid soil, causes an extraordinary intensity‡ of radiant

* I found, at the square of Trinidad, the apparent height of the Silla to be 11° 12′ 49″. It was about four thousand five hundred toises distant.

† Rhododendron ferrugineum of the Alps.

‡ As at Carthago and Ibague in New Grenada.

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caloric. What can we conceive to be more delightful than a temperature which in the day keeps between 20° and 26°;* and at night between 16° and 18°,† which is equally favourable to the plantain, the orange-tree, the coffee-tree, the apple, the apricot, and corn? Jose de Oviedo y Baños, the historiographer of Venezuela, calls the situation of Caracas that of a terrestrial paradise, and compares the Anauco and the neighbouring torrents to the four rivers of the Garden of Eden.

It is to be regretted that this delightful climate is generally inconstant and variable. The inhabitants of Caracas complain of having several seasons in one and the same day; and of the rapid change from one season to another. In the month of January, for instance, a night, of which the mean temperature is 16°, is sometimes followed by a day when the thermometer during eight successive hours keeps above 22° in the shade. In the same day, we may find the temperature of 24° and 18°. These variations are extremely common in our temperate climates of Europe, but in the torrid zone, Europeans themselves are so accustomed to the uniform action of exterior stimulus, that they suffer from a change of temperature of 6°. At Cumana, and everywhere in the plains, the temperature from eleven in the morning to eleven at night changes only 2° or 3°. Moreover, these variations act on the human frame at Caracas more violently than might be supposed from the mere indications of the thermometer. In this narrow valley the atmosphere is in some sort balanced between two winds, one blowing from the west, or the seaside, the other from the east, or the inland country. The first is known by the name of the wind of Catia, because it blows from Catia westward of Cabo Blanco through the ravine of Tipe. It is, however, only a westerly wind in appearance, and it is oftener the breeze of the east and north-east, which, rushing with extreme impetuosity, engulfs itself in the Quebrada de Tipe. Rebounding from the high mountains of Aguas Negras, this wind finds its way back to Caracas, in the direction of the hospital of the Capuchins and the Rio Caraguata. It is loaded with vapours, which it deposits as its temperature decreases, and consequently the summit of the Silla is enveloped in

* Between 16° and 20·8° Reaum.

† Between 12·8° and 14·4° Reaum.

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clouds, when the *catia* blows in the valley. This wind is dreaded by the inhabitants of Caracas; it causes headache in persons whose nervous system is irritable. In order to shun its effects, people sometimes shut themselves up in their houses, as they do in Italy when the sirocco is blowing. I thought I perceived, during my stay at Caracas, that the wind of Catia was purer (a little richer in oxygen) than the *wind of Petare*. I even imagined that its purity might explain its exciting property. The wind of Petare coming from the east and south-east, by the eastern extremity of the valley of the Guayra, brings from the mountains and the interior of the country, a drier air, which dissipates the clouds, and the summit of the Silla rises in all its beauty.

We know that the modifications produced by winds in the composition of the air in various places, entirely escape our eudiometrical experiments, the most precise of which can estimate only as far as ·0003° of oxygen. Chemistry does not yet possess any means of distinguishing two jars of air, the one filled during the prevalence of the sirocco or the catia, and the other before these winds have commenced. It appears to me probable, that the singular effects of the catia, and of all those currents of air, to the influence of which popular opinion attaches so much importance, must be looked for rather in the changes of humidity and of temperature, than in chemical modifications. We need not trace miasms to Caracas from the unhealthy shore on the coast: it may be easily conceived that men accustomed to the drier air of the mountains and the interior, must be disagreeably affected when the very humid air of the sea, pressed through the gap of Tipe, reaches in an ascending current the high valley of Caracas, and, getting cooler by dilatation, and by contact with the adjacent strata, deposits a great portion of the water it contains. This inconstancy of climate, these somewhat rapid transitions from dry and transparent to humid and misty air, are inconveniences which Caracas shares in common with the whole temperate region of the tropics—with all places situated between four and eight hundred toises of elevation, either on table-lands of small extent, or on the slope of the Cordilleras, as at Xalapa in Mexico,

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and Guaduas in New Granada. A serenity, uninterrupted during a great part of the year, prevails only in the low regions at the level of the sea, and at considerable heights on those vast table-lands, where the uniform radiation of the soil seems to contribute to the perfect dissolution of vesicular vapours. The intermediate zone is at the same height as the first strata of clouds which surround the surface of the earth; and the climate of this zone, the temperature of which is so mild, is essentially misty and variable.

Notwithstanding the elevation of the spot, the sky is generally less blue at Caracas than at Cumana. The aqueous vapour is less perfectly dissolved; and here, as in our climates, a greater diffusion of light diminishes the intensity of the aërial colour, by introducing white into the blue of the air. This intensity, measured with the cyanometer of Saussure, was found from November to January generally 18°, never above 20°. On the coasts it was from 22° to 25°. I remarked, in the village of Caracas, that the wind of Petare sometimes contributes singularly to give a pale tint to the celestial vault. On the 22nd of January, the blue of the sky was at noon in the zenith feebler than I ever saw it in the torrid zone.* It corresponded only to 12° of the cyanometer. The atmosphere was then remarkably transparent, without clouds, and of extraordinary dryness. The moment the wind of Petare ceased, the blue colour rose at the zenith as high as 16°. I have often observed at sea, but in a smaller degree, a similar effect of the wind on the colour of the serenest sky.

We know less exactly the mean temperature of Caracas, than that of Santa Fé de Bogotá and of Mexico. I believe, however, I can demonstrate, that it cannot be very distant from twenty to twenty-two degrees. I found by my own observations, during the three very cool months of November, December, and January, taking each day the maximum and minimum of the temperature, the heights were 20·2°; 20·1°; 20·2°.

* At noon, thermometer in the shade 23.7° (in the sun, out of the wind, 30·4°); De Luc's hygrometer, 36·2°; cyanometer, at the zenith, 12°, at the horizon 9°. The wind ceased at three in the afternoon. Therm. 21°; hygr. 39·3°; cyan. 16°. At six o'clock, therm. 20.2°; hygr. 39°.

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Rains are extremely frequent at Caracas in the months of April, May, and June. The storms always come from the east and south-east, from the direction of Petare and La Valle. No hail falls in the low regions of the tropics; yet it occurs at Caracas almost every four or five years. Hail has even been seen in valleys still lower; and this phenomenon, when it does happen, makes a powerful impression on the people. Falls of aërolites are less rare with us than hail in the torrid zone, notwithstanding the frequency of thunder-storms at the elevation of three hundred toises above the level of the sea.

The cool and delightful climate we have just been describing is also suited for the culture of equinoctial productions. The sugar-cane is reared with success, even at heights exceeding that of Caracas; but in the valley, owing to the dryness of the climate, and the stony soil, the cultivation of the coffee-tree is preferred: it yields indeed but little fruit, but that little is of the finest quality. When the shrub is in blossom, the plain extending beyond Chacao presents a delightful aspect. The banana-tree, which is seen in the plantations near the town, is not the great Platano harton; but the varieties *camburi* and *dominico*, which require less heat. The great plantains are brought to the market of Caracas from the haciendas of Turiamo, situated on the coast between Burburata and Porto Cabello. The finest flavoured pine-apples are those of Baruto, of Empedrado, and of the heights of Buenavista, on the road to Victoria. When a traveller for the first time visits the valley of Caracas, he is agreeably surprised to find the culinary plants of our climates, as well as the strawberry, the vine, and almost all the fruit-trees of the temperate zone, growing beside the coffee and banana-tree. The apples and peaches esteemed the best come from Macarao, or from the western extremity of the valley. There, the quince-tree, the trunk of which attains only four or five feet in height, is so common, that it has almost become wild. Preserved apples and quinces, particularly the latter,* are much used in a country where it is thought that, before drinking water, thirst should be excited by sweetmeats. In proportion as the environs of the town have been planted with

* "Dulce de manzana y de membrillo," are the Spanish names of these preserves.

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coffee, and the establishment of plantations (which dates only from the year 1795) has increased the number of agricultural negroes,* the apple and quince-trees scattered in the savannahs have given place, in the valley of Caracas, to maize and pulse. Rice, watered by means of small trenches, was formerly more common than it now is in the plain of Chacao. I observed in this province, as in Mexico and in all the elevated lands of the torrid zone, that, where the apple-tree is most abundant, the culture of the pear-tree is attended with great difficulty. I have been assured, that near Caracas the excellent apples sold in the markets come from trees not grafted. There are no cherry-trees. The olive-trees which I saw in the court of the convent of San Felipe de Neri, were large and fine; but the luxuriance of their vegetation prevented them from bearing fruit.

If the atmospheric constitution of the valley be favourable to the different kinds of culture on which colonial industry is based, it is not equally favourable to the health of the inhabitants, or to that of foreigners settled in the capital of Venezuela. The extreme inconstancy of the weather, and the frequent suppression of cutaneous perspiration, give birth to catarrhal affections, which assume the most various forms. A European, once accustomed to the violent heat, enjoys better health at Cumana, in the valley of Aragua, and in every place where the low region of the tropics is not very humid, than at Caracas, and in those mountain-climates which are vaunted as the abode of perpetual spring.

Speaking of the yellow fever of La Guayra, I mentioned the opinion generally adopted, that this disease is propagated as little from the coast of Venezuela to the capital, as from the coast of Mexico to Xalapa. This opinion is founded on the experience of the last twenty years. The contagious disorders which were severely felt in the port of La Guayra, were scarcely felt at Caracas. I am not convinced that the American typhus, rendered endemic on

* The consumption of provisions, especially meat, is so considerable in the towns of Spanish America, that at Caracas, in 1800, there were 40,000 oxen killed every year: while in Paris, in 1793, with a population fourteen times as great, the number amounted only to 70,000.

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the coast as the port becomes more frequented, if favoured by particular dispositions of the climate, may not become common in the valley: for the mean temperature of Caracas is considerable enough to allow the thermometer, in the hottest months, to keep between twenty-two and twenty-six degrees. The situation of Xalapa, on the declivity of the Mexican mountains, promises more security, because that town is less populous, and is five times farther distant from the sea than Caracas, and two hundred and thirty toises higher: its mean temperature being three degrees cooler. In 1696, a bishop of Venezuela, Diego de Baños, dedicated a church (ermita) to Santa Rosalia of Palermo, for having delivered the capital from the scourge of the black vomit (vomito negro), which is said to have raged for the space of sixteen months. A mass celebrated every year in the cathedral, in the beginning of September, perpetuates the remembrance of this epidemic, in the same manner as processions fix, in the Spanish colonies, the date of the great earthquakes. The year 1696 was indeed very remarkable for the yellow fever, which raged with violence in all the West India Islands, where it had only begun to gain an ascendancy in 1688. But how can we give credit to an epidemical black vomit, having lasted sixteen months without interruption, and which may be said to have passed through that very cool season when the thermometer at Caracas falls to twelve or thirteen degrees? Can the typhus be of older date in the elevated valley of Caracas, than in the most frequented ports of Terra Firma. According to Ulloa, it was unknown in Terra Firma before 1729. I doubt, therefore, the epidemic of 1696 having been the yellow fever, or real typhus of America. Some of the symptoms which accompany yellow fever are common to bilious remittent fevers; and are no more characteristic than *hæmatemeses* of that severe disease now known at the Havannah and Vera Cruz by the name of *vomito*. But though no accurate description satisfactorily demonstrates that the typhus of America existed at Caracas as early as the end of the seventeenth century, it is unhappily too certain, that this disease carried off in that capital a great number of European soldiers in 1802. We are filled with dismay when we reflect that, in the centre of the torrid zone, a table-land

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four hundred and fifty toises high, but very near the sea, does not secure the inhabitants against a scourge which was believed to belong only to the low regions of the coast.

Chapter XIII.

Abode at Caracas.—Mountains in the vicinity of the Town.—Excursion to the Summit of the Silla.—Indications of Mines.

I remained two months at Caracas, where M. Bonpland and I lived in a large house in the most elevated part of the town. From a gallery we could survey at once the summit of the Silla, the serrated ridge of the Galipano, and the charming valley of the Guayra, the rich culture of which was pleasingly contrasted with the gloomy curtain of the surrounding mountains. It was in the dry season, and to improve the pasturage, the savannahs and the turf covering the steepest rocks were set on fire. These vast conflagrations, viewed from a distance, produce the most singular effects of light. Wherever the savannahs, following the undulating slope of the rocks, have filled up the furrows hollowed out by the waters, the flame appears in a dark night like currents of lava suspended over the valley. The vivid but steady light assumes a reddish tint, when the wind, descending from the Silla, accumulates streams of vapour in the low regions. At other times (and this effect is still more curious) these luminous bands, enveloped in thick clouds, appear only at intervals where it is clear; and as the clouds ascend, their edges reflect a splendid light. These various phenomena, so common in the tropics, acquire additional interest from the form of the mountains, the direction of the slopes, and the height of the savannahs covered with alpine grasses. During the day, the wind of Petare, blowing from the east, drives the smoke towards the town, and diminishes the transparency of the air.

If we had reason to be satisfied with the situation of our house, we had still greater cause for satisfaction in the reception we met with from all classes of the inhabitants. Though I have had the advantage, which few Spaniards have

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shared with me, of having successively visited Caracas, the Havannah, Santa Fé de Bogotá, Quito, Lima, and Mexico, and of having been connected in these six capitals of Spanish America with men of all ranks, I will not venture to decide on the various degrees of civilization, which society has attained in the several colonies. It is easier to indicate the different shades of national improvement, and the point towards which intellectual development tends, than to compare and class things which cannot all be considered under one point of view. It appeared to me, that a strong tendency to the study of science prevailed at Mexico and Santa Fé de Bogotá; more taste for literature, and whatever can charm an ardent and lively imagination, at Quito and Lima; more accurate notions of the political relations of countries, and more enlarged views on the state of colonies and their mother-countries, at the Havannah and Caracas. The numerous communications with commercial Europe, with the Caribbean Sea (which we have described as a Mediterranean with many outlets), have exercised a powerful influence on the progress of society in the five provinces of Venezuela and in the island of Cuba. In no other part of Spanish America has civilization assumed a more European character. The great number of Indian cultivators who inhabit Mexico and the interior of New Grenada, impart a peculiar, I may almost say, an exotic aspect, on those vast countries. Notwithstanding the increase of the black population, we seem to be nearer to Cadiz and the United States, at Caracas and the Havannah, than in any other part of the New World.

When, in the reign of Charles V, social distinctions and their consequent rivalries were introduced from the mother-country to the colonies, there arose in Cumana and in other commercial towns of Terra Firma, exaggerated pretensions to nobility on the part of some of the most illustrious families of Caracas, distinguished by the designation of *los Mantuanos*. The progress of knowledge, and the consequent change in manners, have, however, gradually and pretty generally neutralized whatever is offensive in those distinctions among the whites. In all the Spanish colonies there exist two kinds of nobility. One is composed of creoles, whose ancestors only from a very recent period filled great stations

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in America. Their prerogatives are partly founded on the distinction they enjoy in the mother-country; and they imagine they can retain those distinctions beyond the sea, whatever may be the date of their settlement in the colonies. The other class of nobility has more of an American character. It is composed of the descendants of the *Conquistadores*, that is to say, of the Spaniards who served in the army at the time of the first conquest. Among the warriors who fought with Cortez, Losada, and Pizarro, several belonged to the most distinguished families of the Peninsula; others, sprung from the inferior classes of the people, have shed lustre on their names, by that chivalrous spirit which prevailed at the beginning of the sixteenth century. In the records of those times of religious and military enthusiasm, we find, among the followers of the great captains, many simple, virtuous, and generous characters, who reprobated the cruelties which then stained the glory of the Spanish name, but who, being confounded in the mass, have not escaped the general proscription. The name of *Conquistadores* remains the more odious, as the greater number of them, after having outraged peaceful nations, and lived in opulence, did not end their career by suffering those misfortunes which appease the indignation of mankind, and sometimes soothe the severity of the historian.

But it is not only the progress of ideas, and the conflict between two classes of different origin, which have induced the privileged castes to abandon their pretensions, or at least cautiously to conceal them. Aristocracy in the Spanish colonies has a counterpoise of another kind, the action of which becomes every day more powerful. A sentiment of equality, among the whites, has penetrated every bosom. Wherever men of colour are either considered as slaves, or as having been enfranchised, that which constitutes nobility is hereditary liberty—the proud boast of having never reckoned among ancestors any but freemen. In the colonies, the colour of the skin is the real badge of nobility. In Mexico, as well as Peru, at Caracas as in the island of Cuba, a barefooted fellow with a white skin, is often heard to exclaim: "Does that rich man think himself whiter than I am?" The population which Europe pours into America being very considerable, it may easily be supposed, that the axiom,

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'every white man is noble' (*todo blanco es caballero*), must singularly wound the pretensions of many ancient and illustrious European families. But it may be further observed, that the truth of this axiom has long since been acknowledged in Spain, among a people justly celebrated for probity, industry, and national spirit. Every Biscayan calls himself noble; and there being a greater number of Biscayans in America and the Philippine Islands, than in the Peninsula, the whites of that race have contributed, in no small degree, to propagate in the colonies the system of equality among all men whose blood has not been mixed with that of the African race.

Moreover, the countries of which the inhabitants, even without a representative government, or any institution of peerage, annex so much importance to genealogy and the advantages of birth, are not always those in which family aristocracy is most offensive. We do not find among the natives of Spanish origin, that cold and assuming air which the character of modern civilization seems to have rendered less common in Spain than in the rest of Europe. Conviviality, candour, and great simplicity of manner, unite the different classes of society in the colonies, as well as in the mother-country. It may even be said, that the expression of vanity and self-love becomes less offensive, when it retains something of simplicity and frankness.

I found in several families at Caracas a love of information, an acquaintance with the masterpieces of French and Italian literature, and a marked predilection for music, which is greatly cultivated, and which (as always results from a taste for the fine arts) brings the different classes of society nearer to each other. The mathematical sciences, drawing, and painting, cannot here boast of any of those establishments with which royal munificence and the patriotic zeal of the inhabitants have enriched Mexico. In the midst of the marvels of nature, so rich in interesting productions, it is strange that we found no person on this coast devoted to the study of plants and minerals. In a Franciscan convent I met, it is true, with an old monk who drew up the almanac for all the provinces of Venezuela, and who possessed some accurate knowledge of astronomy. Our instruments interested him deeply, and one day our house

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was filled with all the monks of San Francisco, begging to see a dipping-needle. The curiosity excited by physical phenomena is naturally great in countries undermined by volcanic fires, and in a climate where nature is at once so majestic and so mysteriously convulsed.

When we remember, that in the United States of North America, newspapers are published in small towns not containing more than three thousand inhabitants, it seems surprising that Caracas, with a population of forty or fifty thousand souls, should have possessed no printing office before 1806; for we cannot give the name of a printing establishment to a few presses which served only from year to year to promulgate an almanac of a few pages, or the pastoral letter of a bishop. Though the number of those who feel reading to be a necessity is not very considerable, even in the Spanish colonies most advanced in civilization, yet it would be unjust to reproach the colonists for a state of intellectual lassitude which has been the result of a jealous policy. A Frenchman, named Delpeche, has the merit of having established the first printing office in Caracas. It appears somewhat extraordinary that an establishment of this kind should have followed, and not preceded, a political revolution.

In a country abounding in such magnificent scenery, and at a period when, nothwithstanding some symptoms of popular commotion, most of the inhabitants seem only to direct attention to physical objects, such as the fertility of the year, the long drought, or the conflicting winds of Petare and Catia, I expected to find many individuals well acquainted with the lofty surrounding mountains. But I was disappointed; and we could not find in Caracas a single person who had visited the summit of the Silla. Hunters do not ascend so high on the ridges of mountains; and in these countries journeys are not undertaken for such purposes as gathering alpine plants, carrying a barometer to an elevated point, or examining the nature of rocks. Accustomed to a uniform and domestic life, the people dread fatigue and sudden changes of climate. They seem to live not to enjoy life, but only to prolong it.

Our walks led us often in the direction of two coffee plantations, the proprietors of which, Don Andres de Ibarra

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and M. Blandin, were men of agreeable manners. These plantations were situated opposite the Silla de Caracas. Surveying, by a telescope, the steep declivity of the mountains, and the form of the two peaks by which it is terminated, we could form an idea of the difficulties we should have to encounter in reaching its summit. Angles of elevation, taken with the sextant at our house, had led me to believe that the summit was not so high above sea-level as the great square of Quito. This estimate was far from corresponding with the notions entertained by the inhabitants of the city. Mountains which command great towns, have acquired, from that very circumstance, an extraordinary celebrity in both continents. Long before they have been accurately measured, a conventional height is assigned to them; and to entertain the least doubt respecting that height is to wound a national prejudice.

The captain-general, Señor de Guevara, directed the *teniente* of Chacao to furnish us with guides to conduct us on our ascent of the Silla. These guides were negroes, and they knew something of the path leading over the ridge of the mountain, near the western peak of the Silla. This path is frequented by smugglers, but neither the guides, nor the most experienced of the militia, accustomed to pursue the smugglers in these wild spots, had been on the eastern peak, forming the most elevated summit of the Silla. During the whole month of December, the mountain (of which the angles of elevation made me acquainted with the effects of the terrestrial refractions) had appeared only five times free of clouds. In this season two serene days seldom succeed each other, and we were therefore advised not to choose a clear day for our excursion, but rather a time when, the clouds not being elevated, we might hope, after having crossed the first layer of vapours uniformly spread, to enter into a dry and transparent air. We passed the night of the 2d of January in the Estancia de Gallegos, a plantation of coffee-trees, near which the little river of Chacaito, flowing in a luxuriantly shaded ravine, forms some fine cascades in descending the mountains. The night was pretty clear; and though on the day preceding a fatiguing journey it might have been well to have enjoyed some repose, M. Bonpland and I passed the whole night in watching three

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occultations of the satellites of Jupiter. I had previously determined the instant of the observation, but we missed them all, owing to some error of calculation in the Connaissance des Temps. The apparent time had been mistaken for mean time.

I was much disappointed by this accident; and after having observed at the foot of the mountain the intensity of the magnetic forces, before sunrise, we set out at five in the morning, accompanied by slaves carrying our instruments. Our party consisted of eighteen persons, and we all walked one behind another, in a narrow path, traced on a steep acclivity, covered with turf. We endeavoured first to reach a hill, which towards the south-east seems to form a promontory of the Silla. It is connected with the body of the mountain by a narrow dyke, called by the shepherds the Gate, or Puerta de la Silla. We reached this dyke about seven. The morning was fine and cool, and the sky till then seemed to favour our excursion. I saw that the thermometer kept a little below 14° (11·2° Reaum.). The barometer showed that we were already six hundred and eighty-five toises above the level of the sea, that is, nearly eighty toises higher than at the Venta, where we enjoyed so magnificent a view of the coast. Our guides thought that it would require six hours more to reach the summit of the Silla.

We crossed a narrow dyke of rocks covered with turf; which led us from the promontory of the Puerta to the ridge of the great mountain. Here the eye looks down on two valleys, or rather narrow defiles, filled with thick vegetation. On the right is perceived the ravine which descends between the two peaks to the farm of Muñoz; on the left we see the defile of Chacaito, with its waters flowing out near the farm of Gallegos. The roaring of the cascades is heard, while the water is unseen, being concealed by thick groves of erythrina, clusia, and the Indian fig-tree.* Nothing can be more picturesque, in a climate where so many plants have broad, large, shining, and coriaceous leaves, than the aspect of trees when the spectator looks down from a great height above them, and when they are illumined by the almost perpendicular rays of the sun.

* Ficus nymphæifolia, Erythrina mitis. Two fine species of mimosa are found in the same valley; Inga fastuosa, and I. cinerea.

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From the Puerta de la Silla the steepness of the ascent increases, and we were obliged to incline our bodies considerably forwards as we advanced. The slope is often from 30° to 32°.* We felt the want of cramp-irons, or sticks shod with iron. Short grass covered the rocks of gneiss, and it was equally impossible to hold by the grass, or to form steps as we might have done in softer ground. This ascent, which was attended with more fatigue than danger, discouraged those who accompanied us from the town, and who were unaccustomed to climb mountains. We lost a great deal of time in waiting for them, and we did not resolve to proceed alone till we saw them descending the mountain instead of climbing up it. The weather was becoming cloudy; the mist already issued in the form of smoke, and in slender and perpendicular streaks, from a small humid wood which bordered the region of alpine savannahs above us. It seemed as if a fire had burst forth at once on several points of the forest. These streaks of vapour gradually accumulated together, and rising above the ground, were carried along by the morning breeze, and glided like a light cloud over the rounded summit of the mountain.

M. Bonpland and I foresaw from these infallible signs, that we should soon be covered by a thick fog; and lest our guides should take advantage of this circumstance and leave us, we obliged those who carried the most necessary instruments to precede us. We continued climbing the slopes which lead towards the ravine of Chacaito. The familiar loquacity of the Creole blacks formed a striking contrast with the taciturn gravity of the Indians, who had constantly accompanied us in the missions of Caripe. The negroes amused themselves by laughing at the persons who had been in such haste to abandon an expedition so long in preparation; above all, they did not spare a young Capuchin monk, a professor of mathematics, who never ceased to boast of the superior physical strength and courage pos-

* Since my experiments on slopes, mentioned at p. 94, I have discovered in the Figure de la Terre of Bouguer, a passage, which shows that this astronomer, whose opinions are of such weight, considered also 36° as the inclination of a slope quite inaccessible, if the nature of the ground did not admit of forming steps with the foot.

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sessed by all classes of European Spaniards over those born in Spanish America. He had provided himself with long slips of white paper, which were to be cut, and flung on the savannah, to indicate to those who might stray behind, the direction they ought to follow. The professor had even promised the friars of his order to fire off some rockets, to announce to the whole town of Caracas that we had succeeded in an enterprise which to him appeared of the utmost importance. He had forgotten that his long and heavy garments would embarrass him in the ascent. Having lost courage long before the creoles, he passed the rest of the day in a neighbouring plantation, gazing at us through a glass directed to the Silla, as we climbed the mountain. Unfortunately for us, he had taken charge of the water and the provision so necessary in an excursion to the mountains. The slaves, who were to rejoin us, were so long detained by him, that they arrived very late, and we were ten hours without either bread or water.

The eastern peak is the most elevated of the two which form the summit of the mountain, and to this we directed our course with our instruments. The hollow between these two peaks has suggested the Spanish name of Silla (saddle), which is given to the whole mountain. The narrow defile which we have already mentioned, descends from this hollow toward the valley of Caracas, commencing near the western dome. The eastern summit is accessible only by going first to the west of the ravine over the promontory of the Puerta, proceeding straight forward to the lower summit; and not turning to the east till the ridge, or the hollow of the Silla between the two peaks, is nearly reached. The general aspect of the mountain points out this path; the rocks being so steep on the east of the ravine that it would be extremely difficult to reach the summit of the Silla by ascending straight to the eastern dome, instead of going by the way of the Puerta.

From the foot of the cascade of Chacaito to one thousand toises of elevation, we found only savannahs. Two small liliaceous plants, with yellow flowers,* alone lift up their heads, among the grasses which cover the rocks. A few

* Cypura martinicensis, and Sisyrinchium iridifolium. This last is found also near the Venta of La Guayra, at 600 toises of elevation.

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brambles* remind us of the form of our European vegetation. We in vain hoped to find on the mountains of Caracas, and subsequently on the back of the Andes, an eglantine near these brambles. We did not find one indigenous rose-tree in all South America, notwithstanding the analogy existing between the climates of the high mountains of the torrid zone and the climate of our temperate zone. It appears that this charming shrub is wanting in all the southern hemisphere, within and beyond the tropics. It was only on the Mexican mountains that we were fortunate enough to discover, in the nineteenth degree of latitude, American eglantines.†

We were sometimes so enveloped in mist, that we could not, without difficulty, find our way. At this height there is no path, and we were obliged to climb with our hands, when our feet failed us, on the steep and slippery acclivity. A vein filled with porcelain-clay attracted our attention.‡ It is of snowy whiteness, and is no doubt the remains of a decomposed feldspar. I forwarded a considerable portion of it to the intendant of the province. In a country where fuel is not scarce, a mixture of refractory earths may be useful, to improve the earthenware, and even the bricks. Every time that the clouds surrounded us, the thermometer sunk as low as 12° (to 9·6° R.); with a serene sky it rose to 21°. These observations were made in the shade. But it is difficult, on such rapid declivities, covered with a dry, shining, yellow turf, to avoid the effects of radiant heat. We were at nine hundred and forty toises of elevation; and yet at the same height, towards the east, we perceived in a ravine, not merely a few solitary palm-trees, but a whole grove. It was the *palma real;* probably a species of the genus Oreodoxa. This group of palms, at so considerable

* Rubus jamaicensis.

† M. Redouté, in his superb work on rose-trees, has given our Mexican eglantine, under the name of *Rosier de Montezuma,* Montezuma rose.

‡ The breadth of the vein is three feet. This porcelain-clay, when moistened, readily absorbs oxygen from the atmosphere. I found, at Caracas, the residual nitrogen very slightly mingled with carbonic acid, though the experiment was made in phials with ground-glass stoppers, not filled with water.

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an elevation, formed a striking contrast with the willows* scattered on the depth of the more temperate valley of Caracas. We here discovered plants of European forms, situated below those of the torrid zone.

After proceeding for the space of four hours across the savannahs, we entered into a little wood composed of shrubs and small trees, called el Pejual; doubtless from the great abundance here of the *pejoa* (Gaultheria odorata), a plant with very odoriferous leaves.† The steepness of the mountain became less considerable, and we felt an indescribable pleasure in examining the plants of this region. Nowhere, perhaps, can be found collected together, in so small a space, productions so beautiful, and so remarkable in regard to the geography of plants. At the height of a thousand toises, the lofty savannahs of the hills terminate in a zone of shrubs which, by their appearance, their tortuous branches, their stiff leaves, and the magnitude and beauty of their purple flowers, remind us of what is called, in the Cordilleras of the Andes, the vegetation of the *paramos* and the *punas*.‡ We there find the family of the alpine rhododendrons, the thibaudias, the andromedas, the vacciniums, and those befarias with resinous leaves, which we have several times compared to the rhododendron of our European Alps.

Even when nature does not produce the same species in analogous climates, either in the plains of isothermal parallels,§ or on table-lands, the temperature of which re-

* Salix Humboldtiana of Willdenouw. On the alpine palm-trees, see my Prolegomena de Dist. Plant. p. 235.

† It is a great advantage of the Spanish language, and a peculiarity which it shares in common with the Latin, that, from the name of a tree, may be derived a word designating an association or group of trees of the same species. Thus are formed the words *olivar*, *robledar*, and *pinal*, from *olivo*, *roble*, and *pino*. The Hispano-Americans have added *tunal*, *pejual*, *guayaval*, &c., places where a great many Cactuses, Gualtheria odoratas, and Psidiums, grow together.

‡ For the explanation of these words, see p. 178.

§ We may compare together either latitudes which in the same hemisphere present the same mean temperature (as, for instance, Pennsylvania and the central part of France, Chile and the southern part of New Holland); or we may consider the relations that may exist between the vegetation of the two hemispheres under isothermal parallels.

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sembles that of places nearer the poles,* we still remark a striking resemblance of appearance and physiognomy in the vegetation of the most distant countries. This phenomenon is one of the most curious in the history of organic forms. I say the history; for in vain would reason forbid man to form hypotheses on the origin of things; he still goes on puzzling himself with insoluble problems relating to the distribution of beings.

A gramen of Switzerland grows on the granitic rocks of the straits of Magellan.† New Holland contains above forty European phanerogamous plants: and the greater number of those plants, which are found equally in the temperate zones of both hemispheres, are entirely wanting in the intermediary or equinoctial region, as well in the plains as on the mountains. A downy-leaved violet, which terminates in some sort the zone of the phanerogamous plants at Teneriffe, and which was long thought peculiar to that island,‡ is seen three hundred leagues farther north, near the snowy summit of the Pyrenees. Gramina and cyperaceous plants of Germany, Arabia, and Senegal, have

* The geography of plants comprises not merely an examination of the analogies observed in the same hemisphere; as between the vegetation of the Pyrenees and that of the Scandinavian plains; or between that of the Cordilleras of Peru and of the coasts of Chile. It also investigates the relations between the alpine plants of both hemispheres. It compares the vegetation of the Alleghanies and the Cordilleras of Mexico, with that of the mountains of Chile and Brazil. Bearing in mind that every isothermal line has an alpine branch (as, for instance, that which connects Upsala with a point in the Swiss Alps), the great problem of the analogy of vegetable forms may be defined as follows: 1st, examining in each hemisphere, and at the level of the coasts, the vegetation on the same isothermal line, especially near convex or concave summits; 2nd, comparing, with respect to the form of plants, on the same isothermal line north and south of the equator, the alpine branch with that traced in the plains; 3rd, comparing the vegetation on homonymous isothermal lines in the two hemispheres, either in the low regions, or in the alpine regions.

† Phleum alpinum, examined by Mr. Brown. The investigations of this great botanist prove that a certain number of plants are at once common to both hemispheres. Potentilla anserina, Prunella vulgaris, Scirpus mucronatus, and Panicum crus-galli, grow in Germany, in Australia, and in Pennsylvania.

‡ The Viola cheiranthifolia has been found by MM. Kunth and Von Buch among the alpine plants which Jussieu brought from the Pyrenees.

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been recognized among those that were gathered by M. Bonpland and myself on the cold table-lands of Mexico, along the burning shores of the Orinoco, and in the southern hemisphere on the Andes and Quito.* How can we conceive the migration of plants through regions now covered by the ocean? How have the germs of organic life, which resemble each other in their appearance, and even in their internal structure, unfolded themselves at unequal distances from the poles and from the surface of the seas, wherever places so distant present any analogy of temperature? Notwithstanding the influence exercised on the vital functions of plants by the pressure of the air, and the greater or less extinction of light, heat, unequally distributed in different seasons of the year, must doubtless be considered as the most powerful stimulus of vegetation.

The number of identical species in the two continents and in the two hemispheres is far less than the statements of early travellers would lead us to believe. The lofty mountains of equinoctial America have certainly plantains, valerians, arenarias, ranunculuses, medlars, oaks, and pines, which from their physiognomy we might confound with those of Europe; but they are all specifically different. When nature does not present the same species, she loves to repeat the same genera. Neighbouring species are often placed at enormous distances from each other, in the low regions of the temperate zone, and on the alpine heights of the equator. At other times (and the Silla of Caracas affords a striking example of this phenomenon), they are not the European genera, which have sent species to people like colonists the mountains of the torrid zone, but genera of the same tribe, difficult to be distinguished by their appearance, which take the place of each other in different latitudes.

The mountains of New Grenada surrounding the table-lands of Bogotá are more than two hundred leagues distant from those of Caracas, and yet the Silla, the only elevated peak in the chain of low mountains, presents those singular groupings of befarias with purple flowers, of

* Cyperus mucronatus, Poa eragrostis, Festuca myurus, Andropogon avenaceus, Lapago racemosa. (See the Nova Genera et Species Plantarum, vol. i. p. xxv.)

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andromedas, of gualtherias, of myrtilli, of *uvas camaronas*,* of nerteras, and of aralias with hoary leaves,† which characterize the vegetation of the paramos on the high Cordilleras of Santa Fé. We found the same Thibaudia glandulosa at the entrance of the table-land of Bogotá, and in the Pejual of the Silla. The coast-chain of Caracas is unquestionably connected (by the Torito, the Palomera, Tocuyo, and the paramos of Rosas, of Bocono, and of Niquitao) with the high Cordilleras of Merida, Pamplona, and Santa Fé; but from the Silla to Tocuyo, along a distance of seventy leagues, the mountains of Caracas are so low, that the shrubs of the family of the ericineous plants, just cited, do not find the cold climate which is necessary for their development. Supposing, as is probable, that the thibaudias and the rhododendron of the Andes, or befaria, exist in the paramo of Niquitao and in the Sierra de Merida, covered with eternal snow, these plants would nevertheless want a ridge sufficiently lofty and long for their migration towards the Silla of Caracas.

The more we study the distribution of organized beings on the globe, the more we are inclined, if not to abandon the ideas of migration, at least to consider them as hypotheses not entirely satisfactory. The chain of the Andes divides the whole of South America into two unequal longitudinal parts. At the foot of this chain, on the east and west, we found a great number of plants specifically the same. The various passages of the Cordilleras nowhere permit the vegetable productions of the warm regions to proceed from the coats of the Pacific to the banks of the Amazon. When a peak attains a great elevation, either in the middle of very low mountains and plains, or in the centre of an archipelago heaved up by volcanic fires, its summit is covered with alpine plants, many of which are again found, at immense distances, on other mountains

* The names vine-tree, and *uvas camaronas*, are given in the Andes to plants of the genus Thibaudia, on account of their large succulent fruits. Thus the ancient botanists gave the name of bear's vine, *uva ursi*, and vine of Mount Ida (Vitis idæa), to an arbutus and a myrtillus, which belong, like the thibaudia, to the family of the Ericineæ.

† Nertera depressa, Aralia reticulata, Hedyotis blærioIdes.

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having an analogous climate. Such are the general phenomena of the distribution of plants.

It is now said that a mountain is high enough to enter into the limits of the rhododendrons and the befarias, as it has long been said that such a mountain reached the limit of perpetual snow. In using this expression, it is tacitly admitted, that under the influence of certain temperatures, certain vegetable forms must necessarily be developed. Such a supposition, however, taken in all its generality, is not strictly accurate. The pines of Mexico are wanting on the Cordilleras of Peru. The Silla of Caracas is not covered with the oaks which flourish in New Grenada at the same height. Identity of forms indicates an analogy of climate; but in similar climates the species may be singularly diversified.

The charming rhododendron of the Andes (the befaria) was first described by M. Mutis, who observed it near Pamplona and Santa Fé de Bogotá, in the fourth and seventh degree of north latitude. It was so little known before our expedition to the Silla, that it was scarcely to be found in any herbal in Europe. The learned editors of the Flora of Peru had even described it under another name, that of acunna. In the same manner as the rhododendrons of Lapland, Caucasus, and the Alps* differ from each other, the two species of befaria we brought from the Silla† are also specifically different from that of Santa Fé and Bogotá.‡ Near the equator the rhododendrons of the Andes§ cover the mountains as far as the highest paramos, at sixteen and seventeen hundred toises of elevation. Advancing northward, on the Silla de Caracas, we find them much lower, a little below one thousand toises. The befaria recently discovered in Florida, in latitude 30°, grows even on hills of small elevation. Thus in a space of six hundred leagues in latitude, these shrubs descend towards the plains in proportion as their distance

* Rhododendron lapponicum, R. caucasicum, R. ferrugineum, and R. hirsutum.

† Befaria glauca, B. ledifolia.

‡ Befaria æstuans, and B. resinosa.

§ Particularly B. æstuans of Mutis, and two new species of the southern hemisphere, which we have described under the name of B. coarctata, and B. grandiflora.

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from the equator augments. The rhododendron of Lapland grows also at eight or nine hundred toises lower than the rhododendron of the Alps and the Pyrenees. We were surprised at not meeting with any species of befaria in the mountains of Mexico, between the rhododendrons of Santa Fé and Caracas, and those of Florida.

In the small grove which crowns the Silla, the Befaria ledifolia is only three or four feet high. The trunk is divided from its root into a great many slender and even verticillate branches. The leaves are oval, lanceolate, glaucous on their inferior part, and curled at the edges. The whole plant is covered with long and viscous hairs, and emits a very agreeable resinous smell. The bees visit its fine purple flowers, which are very abundant, as in all the alpine plants, and, when in full blossom, they are often nearly an inch wide.

The rhododendron of Switzerland, in those places where it grows, at the elevation of between eight hundred and a thousand toises, belongs to a climate, the mean temperature of which is + 2° and − 1°, like that of the plains of Lapland. In this zone the coldest months are − 4°, and − 10°: the hottest, 12° and 7°. Thermometrical observations, made at the same heights and in the same latitudes, render it probable that, at the Pejual of the Silla, one thousand toises above the Caribbean Sea, the mean temperature of the air is still 17° or 18°; and that the thermometer keeps, in the coolest season, between 15° and 20° in the day, and in the night between 10° and 12°. At the hospital of St. Gothard, situated nearly on the highest limit of the rhododendron of the Alps, the maximum of heat, in the month of August at noon, in the shade, is usually 12° or 13°; in the night, at the same season, the air is cooled by the radiation of the soil down to + 1° or − 1·5°. Under the same barometric pressure, consequently at the same height, but thirty degrees of latitude nearer the equator, the befaria of the Silla is often, at noon, in the sun, exposed to a heat of 23° or 24°. The greatest nocturnal refrigeration probably never exceeds 7°. We have carefully compared the climate, under the influence of which, at different latitudes, two groups of plants of the same family vegetate at equal heights above the level of the sea. The results would have been far different, had we com-

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pared zones equally distant, either from the perpetual snow, or from the isothermal line of 0°.*

In the little thicket of the Pejual, near the purple-flowered befaria, grows a heath-leaved hedyotis, eight feet high; the caparosa,† which is a large arborescent hypericum; a lepidium, which appears identical with that of Virginia; and lastly, lycopodiaceous plants and mosses, which cover the rocks and roots of the trees. That which gives most celebrity in the country to the little thicket, is a shrub ten or fifteen feet high, of the corymbiferous family. The Creoles call it incense (incienso).‡ Its tough and crenate leaves, as well as the extremities of the branches, are covered with a white wool. It is a new species of Trixis, extremely resinous, the flowers of which have the agreeable odour of storax. This smell is very different from that emitted by the leaves of the Trixis terebinthinacea of the mountains of Jamaica, opposite to those of Caracas. The people sometimes mix the incienso of the Silla with the flowers of the pevetera, another composite plant, the smell of which resembles that of the heliotropium of Peru. The pevetera does not, however, grow on the mountains so high as the zone of the befarias; it vegetates in the valley of Chacao, and the ladies of Caracas prepare from it an extremely pleasant odoriferous water.

We spent a long time in examining the fine resinous and fragrant plants of the Pejual. The sky became more and more cloudy, and the thermometer sank below 11°, a temperature at which, in this zone, people begin to suffer from the cold. Quitting the little thicket of alpine plants, we found ourselves again in a savannah. We climbed over a part of the western dome, in order to descend into the hollow of the Silla, a valley which separates the two summits of the

* The stratum of air, the mean temperature of which is 0°, and which scarcely coincides with the superior limit of perpetual snow, is found in the parallel of the rhododendrons of Switzerland at nine hundred toises; in the parallel of the befarias of Caracas, at two thousand seven hundred toises of elevation.

† Vismia caparosa (a loranthus clings to this plant, and appropriates to itself the yellow juice of the vismia); Davallia meifolia, Heracium avilæ, Aralia arborea, Jacq., and Lepidium virginicum. Two new species of lycopodium, the thyoides, and the aristatum, are seen lower down near the Puerta de la Silla.

‡ Trixis nereifolia of M. Bonpland.

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mountain. We there had great difficulties to overcome, occasioned by the force of the vegetation. A botanist would not readily guess that the thick wood covering this valley is formed by the assemblage of a plant of the musaceous family.* It is probably a maranta, or a heliconia; its leaves are large and shining; it reaches the height of fourteen or fifteen feet, and its succulent stalks grow near one another like the stems of the reeds found in the humid regions of the south of Europe.† We were obliged to cut our way through this forest. The negroes walked before with their cutlasses or machetes. The people confound this alpine scitamineous plant with the arborescent gramina, under the name of *carice*. We saw neither its fruit nor flowers. We are surprised to meet with a monocotyledonous family, believed to be exclusively found in the hot and low regions of the tropics, at eleven hundred toises of elevation; much higher than the andromedas, the thibaudias, and the rhododendron of the Cordilleras.‡ In a chain of mountains no less elevated, and more northern (the Blue Mountains of Jamaica), the *Heliconia of the parrots* and the *bihai*, rather grow in the alpine shaded situations.§

Wandering in this thick wood of musaceæ or arborescent plants, we constantly directed our course towards the eastern peak, which we perceived from time to time through an opening. On a sudden we found ourselves enveloped in a thick mist; the compass alone could guide us; but in advancing northward we were in danger at every step of finding ourselves on the brink of that enormous wall of rocks, which descends almost perpendicularly to the depth of six thousand feet towards the sea. We were obliged to halt. Surrounded by clouds sweeping the ground, we began to doubt whether we should reach the eastern peak before night. Happily, the negroes who carried our water and provisions, rejoined us, and we resolved to take some refreshment. Our repast did not last long. Possibly the Capuchin father had not thought of the great number of persons who

* Scitamineous plants, or family of the plantains.

† Arundo donax.

‡ Befaria.

§ Heliconia psittacorum, and H. bihai. These two heliconias are very common in the plains of Terra Firma.

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accompanied us, or perhaps the slaves had made free with our provisions on the way; be that as it may, we found nothing but olives, and scarcely any bread. Horace, in his retreat at Tibur, never boasted of a repast more light and frugal; but olives, which might have afforded a satisfactory meal to a poet, devoted to study, and leading a sedentary life, appeared an aliment by no means sufficiently substantial for travellers climbing mountains. We had watched the greater part of the night, and we walked for nine hours without finding a single spring. Our guides were discouraged; they wished to go back, and we had great difficulty in preventing them.

In the midst of the mist I made trial of the electrometer of Volta, armed with a smoking match. Though very near a thick wood of heliconias, I obtained very sensible signs of atmospheric electricity. It often varied from positive to negative, its intensity changing every instant. These variations, and the conflict of several small currents of air, which divided the mist, and transformed it into clouds, the borders of which were visible, appeared to me infallible prognostics of a change in the weather. It was only two o'clock in the afternoon; we entertained some hope of reaching the eastern summit of the Silla before sunset, and of re-descending into the valley separating the two peaks, intending there to pass the night, to light a great fire, and to make our negroes construct a hut with the leaves of the heliconia. We sent off half of our servants with orders to hasten the next morning to meet us, not with olives, but with a supply of salt beef.

We had scarcely made these arrangements when the east wind began to blow violently from the sea. The thermometer rose to 12·5°. It was no doubt an ascending wind, which, by heightening the temperature, dissolved the vapours. In less than two minutes the clouds dispersed, and the two domes of the Silla appeared to us singularly near. We opened the barometer in the lowest part of the hollow that separates the two summits, near a little pool of very muddy water. Here, as in the West India Islands, marshy plains are found at great elevations; not because the woody mountains attract the clouds, but because they condense the vapours by the effect of nocturnal refrigeration, occasioned

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by the radiation of heat from the ground, and from the parenchyma of the leaves. The mercury was at 21 inches 5·7 lines. We shaped our course direct to the eastern summit. The obstruction caused by the vegetation gradually diminished; it was, however, necessary to cut down some heliconias; but these arborescent plants were not now very thick or high. The peaks of the Silla themselves, as we have several times mentioned, are covered only with gramina and small shrubs of befaria. Their barrenness, however, is not owing to their height: the limit of trees in this region is four hundred toises higher; since, judging according to the analogy of other mountains, this limit would be found here only at a height of eighteen hundred toises. The absence of large trees on the two rocky summits of the Silla may be attributed to the aridity of the soil, the violence of the winds blowing from the sea, and the conflagrations so frequent in all the mountains of the equinoctial region.

To reach the eastern peak, which is the highest, it is necessary to approach as near as possible the great precipice which descends towards Caravalleda and the coast. The gneiss as far as this spot preserves its lamellar texture and its primitive direction; but where we climbed the summit of the Silla, we found it had passed into granite. Its texture becomes granular; the mica, less frequent, is more unequally spread through the rock. Instead of garnets we met with a few solitary crystals of hornblende. It is, however, not a syenite, but rather a granite of new formation. We were three quarters of an hour in reaching the summit of the pyramid. This part of the way is not dangerous, provided the traveller carefully examines the stability of each fragment of rock on which he places his foot. The granite superposed on the gneiss does not present a regular separation into beds: it is divided by clefts, which often cross one another at right angles. Prismatic blocks, one foot wide and twelve long, stand out from the ground obliquely, and appear on the edges of the precipice like enormous beams suspended over the abyss.

Having arrived at the summit, we enjoyed, for a few minutes only, the serenity of the sky. The eye ranged over a vast extent of country: looking down to the north

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was the sea, and to the south, the fertile valley of Caracas. The barometer was at 20 inches 7·6 lines; the thermometer at 13·7°. We were at thirteen hundred and fifty toises of elevation. We gazed on an extent of sea, the radius of which was thirty-six leagues. Persons who are affected by looking downward from a considerable height should remain at the centre of the small flat which crowns the eastern summit of the Silla. The mountain is not very remarkable for height: it is nearly eighty toises lower than the Canigou; but it is distinguished among all the mountains I have visited by an enormous precipice on the side next the sea. The coast forms only a narrow border; and looking from the summit of the pyramid on the houses of Caravalleda, this wall of rocks seems, by an optical illusion, to be nearly perpendicular. The real slope of the declivity appeared to me, according to an exact calculation, 53° 28′.* The mean slope of the peak of Teneriffe is scarcely 12° 30′. A precipice of six or seven thousand feet, like that of the Silla of Caracas, is a phenomenon far more rare than is generally believed by those who cross mountains without measuring their height, their bulk, and their slope. Since the experiments on the fall of bodies, and on their deviation to the south-east, have been resumed in several parts of Europe, a rock of two hundred and fifty toises of perpendicular elevation has been in vain sought for among all the Alps of Switzerland. The declivity of Mont Blanc towards the Allée Blanche does not even reach an angle of 45°; though in the greater number of geological works, Mont Blanc is described as perpendicular on the south side.

At the Silla of Caracas, the enormous northern cliff is partly covered with vegetation, notwithstanding the extreme steepness of its slope. Tufts of befaria and andromedas appear as if suspended from the rock. The little valley which separates the domes towards the south, stretches in the direction of the sea. Alpine plants fill this hollow; and, not confined to the ridge of the mountain, they follow the sinuosities of the ravine. It would seem as if torrents

* Observations of the latitude give for the horizontal distance between the foot of the mountain near Caravalleda, and the vertical line passing through its summit, scarcely 1000 toises.

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were concealed under that fresh foliage; and the disposition of the plants, the grouping of so many inanimate objects, give the landscape all the charm of motion and of life.

Seven months had now elapsed since we had been on the summit of the peak of Teneriffe, whence we surveyed a space of the globe equal to a fourth part of France. The apparent horizon of the sea is there six leagues farther distant than at the top of the Silla, and yet we saw that horizon, at least for some time, very distinctly. It was strongly marked, and not confounded with the adjacent strata of air. At the Silla, which is five hundred and fifty toises lower than the peak of Teneriffe, the horizon, though nearer, continued invisible towards the north and north-north-east. Following with the eye the surface of the sea, which was smooth as glass, we were struck with the progressive diminution of the reflected light. Where the visual ray touched the last limit of that surface, the water was lost among the superposed strata of air. This appearance has something in it very extraordinary. We expect to see the horizon level with the eye; but, instead of distinguishing at this height a marked limit between the two elements, the more distant strata of water seem to be transformed into vapour, and mingled with the aërial ocean. I observed the same appearance, not in one spot of the horizon alone, but on an extent of more than a hundred and sixty degrees, along the Pacific, when I found myself for the first time on the pointed rock that commands the crater of Pichincha; a volcano, the elevation of which exceeds that of Mont Blanc.* The visibility of a very distant horizon depends, when there is no mirage, upon two distinct things: the quantity of light received on that part of the sea where the visual ray terminates; and the extinction of the reflected light during its passage through the intermediate strata of air. It may happen, notwithstanding the serenity of the sky and the transparency of the atmosphere, that the ocean is feebly illuminated at thirty or forty leagues' distance; or that the strata of air nearest the earth may extinguish a great deal of the light, by absorbing the rays that traverse them.

The rounded peak, or western dome of the Silla, con-

* See Views of Nature, Bohn's edition, p. 358.

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cealed from us the view of the town of Caracas; but we distinguished the nearest houses, the villages of Chacao and Petare, the coffee plantations, and the course of the Rio Guayra, a slender streak of water reflecting a silvery light. The narrow band of cultivated ground was pleasingly contrasted with the wild and gloomy aspect of the neighbouring mountains. Whilst contemplating these grand scenes, we feel little regret that the solitudes of the New World are not embellished with the monuments of antiquity.

But we could not long avail ourselves of the advantage arising from the position of the Silla, in commanding all the neighbouring summits. While we were examining with our glasses that part of the sea, the horizon of which was clearly defined, and the chain of the mountains of Ocumare, behind which begins the unknown world of the Orinoco and the Amazon, a thick fog from the plains rose to the elevated regions, first filling the bottom of the valley of Caracas. The vapours, illumined from above, presented a uniform tint of a milky white. The valley seemed overspread with water, and looked like an arm of the sea, of which the adjacent mountains formed the steep shore. In vain we waited for the slave who carried Ramsden's great sextant. Eager to avail myself of the favourable state of the sky, I resolved to take a few solar altitudes with a sextant by Troughton of two inches radius. The disk of the sun was half-concealed by the mist. The difference of longitude between the quarter of the Trinidad and the eastern peak of the Silla appears scarcely to exceed 0° 8′ 22″*.

Whilst, seated on the rock, I was determining the dip of the needle, I found my hands covered with a species of hairy bee, a little smaller than the honey-bee of the north of Europe. These insects make their nests in the ground. They seldom fly; and, from the slowness of their movements, I should have supposed they were benumbed by the cold of the mountains. The people, in these regions, call them *angelitos* (little angels), because they very seldom sting. They are no doubt of the genus Apis, of the division melipones. It has been erroneously affirmed that these

* The difference of longitude between the Silla and La Guayra, according to Fidalgo, is 0° 6′ 40″.

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bees, which are peculiar to the New World, are destitute of all offensive weapons. Their sting is indeed comparatively feeble, and they use it seldom; but a person, not fully convinced of the harmlessness of these angelitos, can scarcely divest himself of a sensation of fear. I must confess, that, whilst engaged in my astronomical observations, I was often on the point of letting my instruments fall, when I felt my hands and face covered with these hairy bees. Our guides assured us that they attempt to defend themselves only when irritated by being seized by their legs. I was not tempted to try the experiment on myself.

The dip of the needle at the Silla was one centesimal degree less than in the town of Caracas. In collecting the observations which I made during calm weather and in very favourable circumstances, on the mountains as well as along the coast, it would at first seem, that we discover, in that part of the globe, a certain influence of the heights on the dip of the needle, and the intensity of the magnetical forces; but we must remark, that the dip at Caracas is much greater than could be supposed, from the situation of the town, and that the magnetical phenomena are modified by the proximity of certain rocks, which constitute so many particular centres or little systems of attraction.*

The temperature of the atmosphere varied on the summit of the Silla from eleven to fourteen degrees, according as the weather was calm or windy. Every one knows how difficult it is to verify, on the summit of a mountain, the temperature, which is to serve for the barometric calculation. The wind was east, which would seem to prove that the trade-winds, extend in this latitude much higher than fifteen hundred toises. Von Buch had observed that, at the peak of Teneriffe, near the northern limit of the trade-winds, there exists generally at the elevation of one thousand nine hundred toises, a contrary current from the

* I have seen fragments of quartz traversed by parallel bands of magnetic iron, carried into the valley of Caracas by the waters descending from the Galipano and the Cerro de Avila. This banded magnetic iron-ore is found also in the Sierra Nevada of Merida. Between the two peaks of the Silla, angular fragments of cellular quartz are found, covered with red oxide of iron. They do not act on the needle. This oxide is of a cinnabar-red colour.

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west. The Academy of Sciences recommended the men of science who accompanied the unfortunate La Pérouse, to employ small air-balloons for the purpose of ascertaining at sea the extent of the trade-winds within the tropics. Such experiments are very difficult. Small balloons do not in general reach the height of the Silla; and the light clouds which are sometimes perceived at an elevation of three or four thousand toises, for instance, the fleecy clouds, called by the French *moutons*, remain almost fixed, or have such a slow motion, that it is impossible to judge of the direction of the wind.

During the short space of time that the sky was serene at the zenith, I found the blue of the atmosphere sensibly deeper than on the coasts. It is probable that, in the months of July and August, the difference between the colour of the sky on the coasts and on the summit of the Silla is still more considerable, but the meteorological phenomenon with which M. Bonpland and myself were most struck during the hour we passed on the mountain, was the apparent dryness of the air, which seemed to increase as the fog augmented.

This fog soon became so dense that it would have been imprudent to remain longer on the edge of a precipice of seven or eight thousand feet deep.* We descended the eastern dome of the Silla, and gathered in our descent a gramen, which not only forms a new and very remarkable genus, but which, to our great astonishment, we found again some time after on the summit of the volcano of Pichincha, at the distance of four hundred leagues from the Silla, in the southern hemisphere.† The Lichen floridus, so common in the north of Europe, covered the branches of the befaria and the Gualtheria odorata, descending even to the roots of these shrubs. Examining the mosses which cover the rocks of gneiss in the valley between the two peaks, I was surprised at finding real pebbles,—rounded fragments of

* In the direction of north-west the slopes appear more accessible; and I have been told of a path frequented by smugglers, which leads to Caravalleda, between the two peaks of the Silla. From the eastern peak I took the bearings of the western peak, 64° 40′ S.W.; and of the houses, which I was told belonged to Caravalleda, 55° 20′ N.W.

† Aegopogon cenchroides.

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quartz.* It may be conceived that the valley of Caracas was once an inland lake, before the Rio Guayra found an issue to the east near Caurimare, at the foot of the hill of Auyamas, and before the ravine of Tipe opened on the west, in the direction of Gatia and Cabo Blanco. But how can we imagine that these waters could ascend as high as the Silla, when the mountains opposite this peak, those of Ocumare, were too low to prevent their overflow into the llanos? The pebbles could not have been brought by torrents from more elevated points, since there is no height that commands the Silla. Must we admit that they have been heaved up, like all the mountains which border the coast.

It was half after four in the afternoon when we finished our observations. Satisfied with the success of our journey, we forgot that there might be danger in descending in the dark, steep declivities covered by a smooth and slippery turf. The mist concealed the valley from us; but we distinguished the double hill of La Puerta, which, like all objects lying almost perpendicularly beneath the eye, appeared extremely near. We relinquished our design of passing the night between the two summits of the Silla, and having again found the path we had cut through the thick wood of heliconia, we soon arrived at the Pejual, the region of odoriferous and resinous plants. The beauty of the befarias, and their branches covered with large purple flowers, again rivetted our attention. When, in these climates, a botanist gathers plants to form his herbal, he becomes difficult in his choice in proportion to the luxuriance of vegetation. He casts away those which have been first cut, because they appear less beautiful than those which were out of reach. Though loaded with plants before quitting the Pejual, we still regretted not having made a more ample harvest. We tarried so long in this spot, that night surprised us as we entered the savannah, at the elevation of upwards of nine hundred toises.

As there is scarcely any twilight in the tropics, we pass suddenly from bright daylight to darkness. The moon was on the horizon; but her disk was veiled from time to time

* Fragments of brown copper-ore were found mixed with these pebbles, at an elevation of 1170 toises.

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by thick clouds, drifted by a cold and rough wind. Rapid slopes, covered with yellow and dry grass, now seen in shade, and now suddenly illumined, seemed like precipices, the depth of which the eye sought in vain to measure. We proceeded onwards, in single file, and endeavoured to support ourselves by our hands, lest we should roll down. The guides, who carried our instruments, abandoned us successively, to sleep on the mountain. Among those who remained with us was a Congo black, who evinced great address, bearing on his head a large dipping-needle: he held it constantly steady, notwithstanding the extreme declivity of the rocks. The fog had dispersed by degrees in the bottom of the valley; and the scattered lights we perceived below us caused a double illusion. The steeps appeared still more dangerous than they really were; and, during six hours of continual descent, we seemed to be always equally near the farms at the foot of the Silla. We heard very distinctly the voices of men and the notes of guitars. Sound is generally so well propagated upwards, that in a balloon at the elevation of three thousand toises, the barking of dogs is sometimes heard.*

We did not arrive till ten at night at the bottom of the valley. We were overcome with fatigue and thirst, having walked for fifteen hours, nearly without stopping. The soles of our feet were cut and torn by the asperities of a rocky soil and the hard and dry stalks of the gramina, for we had been obliged to pull off our boots, the soles having become too slippery. On declivities devoid of shrubs or ligneous herbs, which may be grasped by the hand, the danger of the descent is diminished by walking barefoot. In order to shorten the way, our guides conducted us from the Puerta de la Silla to the farm of Gallegos by a path leading to a reservoir of water, called el Tanque. They missed their way, however; and this last descent, the steepest of all, brought us near the ravine of Chacarto. The noise of the cascades gave this nocturnal scene a grand and wild character.

We passed the night at the foot of the Silla. Our friends at Caracas had been able to distinguish us with glasses on

* Gay-Lussac's account of his ascent on the 15th of September, 1805.

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the summit of the eastern peak. They felt interested in hearing the account of our expedition, but they were not satisfied with the result of our measurement, which did not assign to the Silla even the elevation of the highest summit of the Pyrenees.* One cannot blame the national feeling which suggests exaggerated ideas of the monuments of nature, in a country in which the monuments of art are nothing; nor can we wonder that the inhabitants of Quito and Riobamba, who have prided themselves for ages on the height of Chimborazo, mistrust those measurements which elevate the mountains of Himalaya above all the colossal Cordilleras?

During our journey to the Silla, and in all our excursions in the valley of Caracas, we were very attentive to the lodes and indications of ore which we found in the strata of gneiss. No regular diggings having been made, we could only examine the fissures, the ravines, and the land-slips occasioned by torrents in the rainy season. The rock of gneiss, passing sometimes into a granite of new formation, sometimes into mica-slate,† belongs in Germany to the most metalliferous rocks; but in the New Continent, the gneiss has not hitherto been remarked as very rich in ores worth working. The most celebrated mines of Mexico and Peru are found in the primitive and transition schists, in the trap-porphyries, the grauwakke, and the alpine limestones. In several spots of the valley of Caracas, the gneiss contains a small quantity of gold, disseminated in small veins of quartz, sulphuretted silver, azure copper-ore, and galena; but it is doubtful whether these different metalliferous substances are not too poor to encourage any attempt at working them. Such attempts were, however, made at the conquest of the province, about the middle of the sixteenth century.

From the promontory of Paria to beyond cape Vela, the early navigators had seen gold ornaments and gold dust, in the possession of the inhabitants of the coast. They penetrated into the interior of the country, to discover whence the

* It was formerly believed that the height of the Silla of Caracas scarcely differed from that of the peak of Teneriffe.

† Especially at great elevations.

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precious metal came; and though the information obtained in the province of Coro, and the markets of Curiana and Cauchieto,* clearly proved that real mineral wealth was to be found only to the west and south-west of Coro (that is to say, in the mountains near those of New Grenada), the whole province of Caracas was nevertheless eagerly explored. A governor, newly arrived on that coast, could recommend himself to the Spanish court only by boasting of the mines of his province; and in order to take from cupidity what was most ignoble and repulsive, the thirst of gold was justified by the purpose to which it was pretended the riches acquired by fraud and violence might be employed. "Gold," says Christopher Columbus, in his last letter † to King Ferdinand, "gold is a thing so much the more necessary to your majesty, because, in order to fulfil the ancient prophecy, Jerusalem is to be rebuilt by a prince of the Spanish monarchy. Gold is the most excellent of metals. What becomes of those precious stones, which are sought for at the extremities of the globe? They are sold, and are finally converted into gold. With gold we not only do whatever we please in this world, but we can even employ it to snatch souls from Purgatory, and to people Paradise." These words bear the stamp of the age in which Columbus lived; but we are surprised to see this pompous eulogium of riches written by a man whose whole life was marked by the most noble disinterestedness.

The conquest of the province of Venezuela having been begun at its western extremity, the neighbouring mountains of Coro, Tocuyo, and Barquisimeto, first attracted the at-

* The Spaniards found, in 1500, in the country of Curiana (now Coro), little birds, frogs, and other ornaments made of gold. Those who had cast these figures lived at Cauchieto, a place nearer the Rio de la Hacha. I have seen ornaments resembling those described by Peter Martyr of Anghiera (which indicate tolerable skill in goldsmiths' work), among the remains of the ancient inhabitants of Cundinamarca. The same art appears to have been practised in places along the coasts, and also farther to the south, among the mountains of New Grenada.

† Lettera rarissima data nelle Indie nella isola di Jamaica a 7 Julio del 1503.—"Le oro è metallo sopra gli altri excellentissimo; e dell' oro si fanno li tesori e chi lo tiene fa e opera quanto vuole nel mondo, e finalmente aggionge a mandare le anime al Paradiso."

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tention of the Conquistadores. These mountains join the Cordilleras of New Grenada (those of Santa Fé, Pamplona, la Grita, and Merida) to the littoral chain of Caracas. It is a land the more interesting in a geognostical point of view, as no map has yet made known the mountainous ramifications which the paramos of Niquitao and Las Rosas send out towards the north-east. Between Tocuyo, Araure, and Barquisimeto, rises the group of the Altar Mountains, connected on the south-east with the paramo of Las Rosas. A branch of the Altar stretches north-east by San Felipe el Fuerte, joining the granitic mountains of the coast near Porto Cabello. The other branch takes an eastward direction towards Nirgua and Tinaco, and joins the chain of the interior, that of Yusma, Villa de Cura, and Sabana de Ocumare.

The region we have been here describing separates the waters which flow to the Orinoco from those which run into the immense lake of Maracaybo and the Caribbean Sea. It includes climates which may be termed temperate rather than hot; and it is looked upon in the country, notwithstanding the distance of more than a hundred leagues, as a prolongation of the metalliferous soil of Pamplona. It was in the group of the western mountains of Venezuela, that the Spaniards, in the year 1551, worked the gold mine of Buria,* which was the origin of the foundation of the town of Barquisimeto.† But these works, like many other mines successively opened, were soon abandoned. Here, as in all the mountains of Venezuela, the produce of the ore has been found to be very variable. The lodes are very often divided, or they altogether cease; and the metals appear only in kidney-ores, and present the most delusive appearances. It is, however, only in this group of mountains of San Felipe and Barquisimeto, that the working of mines has been continued till the present time. Those of Aroa, near San Felipe el Fuerte, situated in the centre of a very insalubrious country, are the only mines which are wrought in the whole capitania-general of Caracas. They yield a small quantity of copper.

* Real de Minas de San Felipe de Buria.
† Nueva Segovia.

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Next to the works at Buria, near Barquisimeto, those of the valley of Caracas, and of the mountains near the capital, are the most ancient. Francisco Faxardo and his wife Isabella, of the nation of the Guaiqueries,* often visited the table-land where the capital of Venezuela is now situated. They had given this table-land the name of Valle de San Francisco; and having seen some bits of gold in the hands of the natives, Faxardo succeeded, in the year 1560, in discovering the mines of Los Teques,† to the south-west of Caracas, near the group of the mountains of Cocuiza, which separate the valleys of Caracas and Aragua. It is thought that in the first of these valleys, near Baruta, south of the village of Valle, the natives had made some excavations in veins of auriferous quartz; and that, when the Spaniards first settled there, and founded the town of Caracas, they filled the shafts, which had been dry, with water. It is now impossible to ascertain this fact; but it is certain that, long before the Conquest, grains of gold were a medium of exchange, I do not say generally, but among certain nations of the New Continent. They gave gold for the purchase of pearls; and it does not appear extraordinary, that, after having for a long time picked up grains of gold in the rivulets, people who had fixed habitations, and were devoted to agriculture, should have tried to trace the auriferous veins in the superior surface of the soil. The mines of Los Teques could not be peaceably wrought, till the defeat of the Cacique Guaycaypuro, a celebrated chief of the Teques, who long contested with the Spaniards the possession of the province of Venezuela.

We have yet to mention a third point to which the attention of the Conquistadores was called by indications

* Faxardo and his wife were the founders of the town of the Collado, now called Caravalleda.

† Thirteen years later, in 1573, Gabriel de Avila, one of the alcaldes of the new town of Caracas, renewed the working of these mines, which were from that time called the "Real de Minas de Nuestra Señora." Probably this same Avila, on account of a few farms which he possessed in the mountains adjacent to La Guayra and Caracas, has occasioned the Cumbre to receive the name of Montaña de Avila. This name has subsequently been applied erroneously to the Silla, and to all the chain which extends towards cape Codera.

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of mines, so early as the end of the sixteenth century. In following the valley of Caracas eastward beyond Caurimare, on the road to Caucagua, we reach a mountainous and woody country, where a great quantity of charcoal is now made, and which anciently bore the name of the Province of Los Mariches. In these eastern mountains of Venezuela, the gneiss passes into the state of talc. It contains, as at Salzburg, lodes of auriferous quartz. The works anciently begun in those mines have often been abandoned and resumed.

The mines of Caracas were forgotten during more than a hundred years. But at a period comparatively recent, about the end of the last century, an Intendant of Venezuela, Don Jose Avalo, again fell into the illusions which had flattered the cupidity of the Conquistadores. He fancied that all the mountains near the capital contained great metallic riches. Some Mexican miners were engaged, and their operations were directed to the ravine of Tipe, and the ancient mines of Baruta to the south of Caracas, where the Indians gather even now some little gold-washings. But the zeal which had prompted the enterprise soon diminished, and after much useless expense, the working of the mines of Caracas was totally abandoned. A small quantity of auriferous pyrites, sulphuretted silver, and a little native gold, were found; but these were only feeble indications; and in a country where labour is extremely dear, there was no inducement to pursue works so little productive.

We visited the ravine of Tipe, situated in that part of the valley which opens in the direction of Cabo Blanco. Proceeding from Caracas, we traverse, in the direction of the great barracks of San Carlos, a barren and rocky soil. Only a very few plants of Argemone mexicana are to be found. The gneiss appears everywhere above ground. We might have fancied ourselves on the table-land of Freiberg. We crossed first the little rivulet of Agua Salud, a limpid stream, which has no mineral taste, and then the Rio Caraguata. The road is commanded on the right by the Cerro de Avila and the Cumbre; and on the left, by the mountains of Aguas Negras. This defile is very interesting in a geological point of view. At this spot the valley of Caracas commu-

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nicates, by the valleys of Tacagua and of Tipe, with the coast near Catia. A ridge of rock, the summit of which is forty toises above the bottom of the valley of Caracas, and more than three hundred toises above the valley of Tacagua, divides the waters which flow into the Rio Guayra and towards Cabo Blanco. On this point of division, at the entrance of the branch, the view is highly pleasing. The climate changes as we descend westward. In the valley of Tacagua we found some new habitations, and also *conucos* of maize and plantains. A very extensive plantation of tuna, or cactus, stamps this barren country with a peculiar character. The cactuses reach the height of fifteen feet, and grow in the form of candelabra, like the euphorbia of Africa. They are cultivated for the purpose of selling their refreshing fruits in the market of Caracas. The variety which has no thorns is called, strangely enough, in the colonies, *tuna de España* (Spanish cactus). We measured, at the same place, magueys or agaves, the long stems of which, laden with flowers, were forty-four feet high. However common this plant is become in the south of Europe, the native of a northern climate is never weary of admiring the rapid development of a liliaceous plant, which contains at once a sweet juice and astringent and caustic liquids, employed to cauterize wounds.

We found several veins of quartz in the valley of Tipe visible above the soil. They contained pyrites, carbonated iron-ore, traces of sulphuretted silver (glasserz), and grey copper-ore (fahlerz). The works which had been undertaken, either for extracting the ore, or exploring the nature of its bed, appeared to be very superficial. The earth falling in had filled up those excavations, and we could not judge of the richness of the lobe. Notwithstanding the expense incurred under the intendancy of Don Jose Avalo, the great question whether the province of Venezuela contains mines rich enough to be worked, is yet problematical. Though in countries where hands are wanting, the culture of the soil demands unquestionably the first care of the government, yet the example of New Spain sufficiently proves that mining is not always unfavourable to the progress of agriculture. The best-cultivated Mexican

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lands, those which remind the traveller of the most beautiful districts of France and the south of Germany, extend from Silao towards the Villa of Leon: they are in the neighbourhood of the mines of Guanaxuato, which alone furnish a sixth part of all the silver of the New World.

Chapter XIV.

Earthquakes at Caracas.—Connection of those Phenomena with the Volcanic Eruptions of the West India Islands.

On the evening of the 7th of February we took our departure from Caracas. Since the period of our visit to that place, tremendous earthquakes have changed the surface of the soil. The city, which I have described, has disappeared; and on the same spot, on the ground fissured in various directions, another city is now slowly rising. The heaps of ruins, which were the grave of a numerous population, are becoming anew the habitation of men. In retracing changes of so general an interest, I shall be led to notice events which took place long after my return to Europe. I shall pass over in silence the popular commotions which have taken place, and the modifications which society has undergone. Modern nations, careful of their own remembrances, snatch from oblivion the history of human revolutions, which is, in fact, the history of ardent passions and inveterate hatred. It is not the same with respect to the revolutions of the physical world. These are described with least accuracy when they happen to be contemporary with civil dissensions. Earthquakes and eruptions of volcanos strike the imagination by the evils which are their necessary consequence. Tradition seizes on whatever is vague and marvellous; and amid great public calamities, as in private misfortunes, man seems to shun that light which leads us to discover the real causes of events, and to understand the circumstances by which they are attended.

I have recorded in this work all I have been able to

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collect, and on the accuracy of which I can rely, respecting the earthquake of the 26th of March, 1812. By that catastrophe the town of Caracas was destroyed, and more than twenty thousand persons perished throughout the extent of the province of Venezuela. The intercourse which I have kept up with persons of all classes has enabled me to compare the description given by many eye-witnesses, and to interrogate them on objects that may throw light on physical science in general. The traveller, as the historian of nature, should verify the dates of great catastrophes, examine their connection and their mutual relations, and should mark in the rapid course of ages, in the continual progress of successive changes, those fixed points with which other catastrophes may one day be compared. All epochs are proximate to each other in the immensity of time comprehended in the history of nature. Years which have passed away seem but a few instants; and the physical descriptions of a country, even when they offer subjects of no very powerful and general interest, have at least the advantage of never becoming old. Similar considerations, no doubt, led M. de la Condamine to describe in his Voyage à l'Equateur, the memorable eruptions of the volcano of Cotopaxi,* which took place long after his departure from Quito. I feel the less hesitation in following the example of that celebrated traveller, as the events I am about to relate will help to elucidate the theory of volcanic reaction, or the influence of a system of volcanos on a vast space of circumjacent territory.

At the time when M. Bonpland and myself visited the provinces of New Andalusia, New Barcelona, and Caracas, it was generally believed that the most eastern parts of those coasts were especially exposed to the destructive effects of earthquakes. The inhabitants of Cumana dreaded the valley of Caracas, on account of its damp and variable climate, and its gloomy and misty sky; whilst the inhabitants of the temperate valley regarded Cumana as a town whose inhabitants incessantly inhaled a burning atmosphere, and whose soil was periodically agitated by violent commotions. Unmindful of the overthrow of Riobamba and other very

* Those of the 30th of November, 1744, and of the 3rd of September, 1750.

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elevated towns, and not aware that the peninsula of Araya, composed of mica-slate, shares the commotions of the calcareous coast of Cumana, well-informed persons imagined they discerned security in the structure of the primitive rocks of Caracas, as well as in the elevated situation of this valley. Religious ceremonies celebrated at La Guayra, and even in the capital, in the middle of the night,* doubtless called to mind the fact that the province of Venezuela had been subject at intervals to earthquakes; but dangers of rare occurrence are slightly feared. However, in the year 1811, fatal experience destroyed the illusion of theory and of popular opinion. Caracas, situated in the mountains, three degrees west of Cumana, and five degrees west of the volcanos of the Caribbee islands, has suffered greater shocks than were ever experienced on the coast of Paria or New Andalusia.

At my arrival in Terra Firma, I was struck with the connection between the destruction of Cumana on the 14th of December, 1797, and the eruption of the volcanos in the smaller West India Islands. This connection was again manifest in the destruction of Caracas on the 26th of March, 1812. The volcano of Guadaloupe seemed in 1797 to have exercised a reaction on the coasts of Cumana. Fifteen years later, it was a volcano situated nearer the continent (that of St. Vincent), which appeared to have extended its influence as far as Caracas and the banks of Apure. Possibly, at both those periods, the centre of the explosion was, at an immense depth, equally distant from the regions towards which the motion was propagated at the surface of the globe.

From the beginning of 1811 to 1813, a vast superficies of the earth,† bound by the meridian of the Azores, the valley of the Ohio, the Cordilleras of New Grenada, the coasts of Venezuela, and the volcanos of the smaller West India Islands, was shaken throughout its whole extent, by com-

* For instance, the nocturnal procession of the 21st of October, instituted in commemoration of the great earthquake which took place on that day of the month, at one o'clock in the morning, in 1778. Other very violent shocks were those of 1641, 1703, and 1802.

† Between latitudes 5° and 36° North, and 31° and 91° West lon. from Paris.

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motions which may be attributed to subterranean fires. The following series of phenomena seems to indicate communications at enormous distances. On the 30th of January, 1811, a submarine volcano broke out near the island of St. Michael, one of the Azores. At a place where the sea was sixty fathoms deep, a rock made its appearance above the surface of the waters. The heaving-up of the softened crust of the globe appears to have preceded the eruption of flame at the crater, as had already been observed at the volcanos of Jorullo in Mexico, and on the appearance of the little island of Kameni, near Santorino. The new islet of the Azores was at first a mere shoal; but on the 15th of June, an eruption, which lasted six days, enlarged its extent, and carried it progressively to the height of fifty toises above the surface of the sea. This new land, of which captain Tillard took possession in the name of the British government, giving it the name of Sabrina Island, was nine hundred toises in diameter. It has again, it seems, been swallowed up by the ocean. This is the third time that submarine volcanos have presented this extraordinary spectacle near the island of St. Michael; and, as if the eruptions of these volcanos were subject to periodical recurrence, owing to a certain accumulation of elastic fluids, the island raised up has appeared at intervals of ninety-one or ninety-two years.*

At the time of the appearance of the new island of Sabrina, the smaller West India Islands, situated eight hundred leagues south-west of the Azores, experienced frequent earthquakes. More than two hundred shocks were felt from the month of May 1811, to April 1812, at St. Vincent; one of the three islands in which there are still active volcanos. The commotion was not circumscribed to the insular portion of eastern America; and from the 16th of December, 1811, till the year 1813, the earth was almost incessantly agitated in the valleys of the Mississippi,

* Malte-Brun, Géographie Universelle. There is, however, some doubt respecting the eruption of 1628, to which some accounts assign the date of 1638. The rising always happened near the island of St. Michael, though not identically on the same spot. It is remarkable that the small island of 1720 reached the same elevation as the island of Sabrina in 1811.

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the Arkansas river, and the Ohio. The oscillations were more feeble on the east of the Alleghanies, than to the west of these mountains, in Tennessee and Kentucky. They were accompanied by a great subterranean noise, proceeding from the south-west. In some places between New Madrid and Little Prairie, as at the Saline, north of Cincinnati, in latitude 37° 45′, shocks were felt every day, nay almost every hour, during several months. The whole of these phenomena continued from the 16th of December 1811, till the year 1813. The commotion, confined at first to the south, in the valley of the lower Mississippi, appeared to advance slowly northward.

Precisely at the period when this long series of earthquakes commenced in the Transalleghanian States (in the month of December 1811), the town of Caracas felt the first shock in calm and serene weather. This coincidence of phenomena was probably not accidental; for it must be borne in mind that, notwithstanding the distance which separates these countries, the low grounds of Louisiana and the coasts of Venezuela and Cumana belong to the same basin, that of the Gulf of Mexico. When we consider geologically the basin of the Caribbean Sea, and of the Gulf of Mexico, we find it bounded on the south by the coast-chain of Venezuela and the Cordilleras of Merida and Pamplona; on the east by the mountains of the West India Islands, and the Alleghanies; on the west by the Andes of Mexico, and the Rocky Mountains; and on the north by the very inconsiderable elevations which separate the Canadian lakes from the rivers which flow into the Mississippi. More than two-thirds of this basin are covered with water. It is bordered by two ranges of active volcanos; on the east, in the Carribee Islands, between latitudes 13° and 16°; and on the west in the Cordilleras of Nicaragua, Guatimala, and Mexico, between latitudes 11° and 20°. When we reflect that the great earthquake at Lisbon, of the 1st of November, 1755, was felt almost simultaneously on the coasts of Sweden, at lake Ontario, and at the island of Martinique, it may not seem unreasonable to suppose, that all this basin of the West Indies, from Cumana and Caracas as far as the plains of Louisiana, should be simultaneously agitated by commotions proceeding from the same centre of action.

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It is an opinion very generally prevalent on the coasts of Terra Firma, that earthquakes become more frequent when electric explosions have been during some years rare. It is supposed to have been observed, at Cumana and at Caracas, that the rains were less frequently attended with thunder from the year 1792; and the total destruction of Cumana in 1797, as well as the commotions felt in 1800, 1801, and 1802, at Maracaibo, Porto Cabello, and Caracas, have not failed to be attributed to an accumulation of electricity in the interior of the earth. Persons who have lived long in New Andalusia, or in the low regions of Peru, will admit that the period most to be dreaded for the frequency of earthquakes is the beginning of the rainy season, which, however, is also the season of thunder-storms. The atmosphere and the state of the surface of the globe seem to exercise an influence unknown to us on the changes which take place at great depths; and I am inclined to think that the connection which it is supposed has been traced between the absence of thunder-storms and the frequency of earthquakes, is rather a physical hypothesis framed by the half-learned of the country than the result of long experience. The coincidence of certain phenomena may be favoured by chance. The extraordinary commotions felt almost continually during the space of two years on the banks of the Mississippi and the Ohio, and which corresponded in 1812 with those of the valley of Caracas, were preceded at Louisiana by a year almost exempt from thunder-storms. The public mind was again struck with this phenomenon. We cannot be surprised that there should be in the native land of Franklin a great readiness to receive explanations founded on the theory of electricity.

The shock felt at Caracas in the month of December 1811, was the only one which preceded the terrible catastrophe of the 26th of March, 1812. The inhabitants of Terra Firma were alike ignorant of the agitations of the volcano in the island of St. Vincent, and of those felt in the basin of the Mississippi, where, on the 7th and 8th of February, 1812, the earth was day and night in perpetual oscillation. A great drought prevailed at this period in the province of Venezuela. Not a single drop of rain had fallen at Caracas or in the country to the distance of ninety

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leagues round, during five months preceding the destruction of the capital. The 26th of March was a remarkably hot day. The air was calm, and the sky unclouded. It was Ascension-day, and a great portion of the population was assembled in the churches. Nothing seemed to presage the calamities of the day. At seven minutes after four in the afternoon the first shock was felt. It was sufficiently forcible to make the bells of the churches toll; and it lasted five or six seconds. During that interval the ground was in a continual undulating movement, and seemed to heave up like a boiling liquid. The danger was thought to be past, when a tremendous subterranean noise was heard, resembling the rolling of thunder, but louder and of longer continuance than that heard within the tropics in the time of storms. This noise preceded a perpendicular motion of three or four seconds, followed by an undulatory movement somewhat longer. The shocks were in opposite directions, proceeding from north to south, and from east to west. Nothing could resist the perpendicular movement and the transverse undulations. The town of Caracas was entirely overthrown, and between nine and ten thousand of the inhabitants were buried under the ruins of the houses and churches. The procession of Ascension-day had not yet begun to pass through the streets, but the crowd was so great within the churches that nearly three or four thousand persons were crushed by the fall of the roofs. The explosion was most violent towards the north, in that part of the town situated nearest the mountain of Avila and the Silla. The churches of la Trinidad and Alta Gracia, which were more than one hundred and fifty feet high, and the naves of which were supported by pillars of twelve or fifteen feet diameter, were reduced to a mass of ruins scarcely exceeding five or six feet in elevation. The sinking of the ruins has been so considerable that there now scarcely remain any vestiges of pillars or columns. The barracks, called el Quartel de San Carlos, situated north of the church of la Trinidad, on the road from the custom-house of La Pastora, almost entirely disappeared. A regiment of troops of the line, under arms, and in readiness to join the procession, was, with the exception of a few men, buried beneath the ruins of the barracks. Nine-tenths of the fine city of

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Caracas were entirely destroyed. The walls of some houses not thrown down, as those in the street San Juan, near the Capuchin Hospital, were cracked in such a manner as to render them uninhabitable. The effects of the earthquake were somewhat less violent in the western and southern parts of the city, between the principal square and the ravine of Caraguata. There, the cathedral, supported by enormous buttresses, remains standing.

It is computed that nine or ten thousand persons were killed in the city of Caracas, exclusive of those who, being dangerously wounded, perished several months after, for want of food and proper care. The night of the Festival of the Ascension witnessed an awful scene of desolation and distress. The thick cloud of dust which, rising above the ruins, darkened the sky like a fog, had settled on the ground. No commotion was felt, and never was a night more calm or more serene. The moon, then nearly at the full, illumined the rounded domes of the Silla, and the aspect of the sky formed a perfect contrast to that of the earth, which was covered with the bodies of the dead, and heaped with ruins. Mothers were seen bearing in their arms their children, whom they hoped to recall to life. Desolate families were wandering through the city, seeking a brother, a husband, or a friend, of whose fate they were ignorant, and whom they believed to be lost in the crowd. The people pressed along the streets, which could be traced only by long lines of ruins.

All the calamities experienced in the great catastrophes of Lisbon, Messina, Lima, and Riobamba were renewed at Caracas on the fatal 26th of March, 1812. Wounded persons, buried beneath the ruins, were heard imploring by their cries the help of the passers-by, and nearly two thousand were dug out. Never was pity more tenderly evinced; never was it more ingeniously active than in the efforts employed to save the miserable victims whose groans reached the ear. Implements for digging and clearing away the ruins were entirely wanting; and the people were obliged to use their bare hands, to disinter the living. The wounded, as well as the invalids who had escaped from the hospitals, were laid on the banks of the small river Guayra, where there was no shelter but the foliage of trees. Beds, linen to dress the

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wounds, instruments of surgery, medicines, every object of the most urgent necessity, was buried in the ruins. Everything, even food, was wanting; and for the space of several days water became scarce in the interior of the city. The commotion had rent the pipes of the fountains; and the falling in of the earth had choaked up the springs that supplied them. To procure water it was necessary to go down to the river Guayra, which was considerably swelled; and even when the water was obtained vessels for conveying it were wanting.

There was a duty to be fulfilled to the dead, enjoined at once by piety and the dread of infection. It being impossible to inter so many thousand bodies, half-buried under the ruins, commissioners were appointed to burn them: and for this purpose funeral piles were erected between the heaps of ruins. This ceremony lasted several days. Amidst so many public calamities, the people devoted themselves to those religious duties which they thought best fitted to appease the wrath of heaven. Some, assembling in processions, sang funeral hymns; others, in a state of distraction, made their confessions aloud in the streets. In Caracas was then repeated what had been remarked in the province of Quito, after the tremendous earthquake of 1797; a number of marriages were contracted between persons who had neglected for many years to sanction their union by the sacerdotal benediction. Children found parents, by whom they had never till then been acknowledged; restitutions were promised by persons who had never been accused of fraud; and families who had long been at enmity were drawn together by the tie of common calamity. But if this feeling seemed to calm the passions of some, and open the heart to pity, it had a contrary effect on others, rendering them more rigorous and inhuman. In great calamities vulgar minds evince less of goodness than of energy. Misfortune acts in the same manner as the pursuits of literature and the study of nature; the happy influence of which is felt only by a few, giving more ardour to sentiment, more elevation to the thoughts, and increased benevolence to the disposition.

Shocks as violent as those which in about the space of a

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minute*, overthrew the city of Caracas, could not be confined to a small portion of the continent. Their fatal effects extended as far as the provinces of Venezuela, Varinas, and Maracaibo, along the coast; and especially to the inland mountains. La Guayra, Mayquetia, Antimano, Baruta, La Vega, San Felipe, and Merida, were almost entirely destroyed. The number of the dead exceeded four or five thousand at La Guayra, and at the town of San Felipe, near the copper-mines of Aroa. It would appear that on a line running E.N.E. and W.S.W. from La Guayra and Caracas to the lofty mountains of Niquitao and Merida, the violence of the earthquake was principally directed. It was felt in the kingdom of New Grenada from the branches of the high Sierra de Santa Martha† as far as Santa Fé de Bogotá and Honda, on the banks of the Magdalena, one hundred and eighty leagues from Caracas. It was everywhere more violent in the Cordilleras of gneiss and mica-slate, or immediately at their base, than in the plains; and this difference was particularly striking in the savannahs of Varinas and Casanara.‡ In the valleys of Aragua, between Caracas and the town of San Felipe, the commotions were very slight; and La Victoria, Maracay, and Valencia, scarcely suffered at all, notwithstanding their proximity to the capital. At Valecillo, a few leagues from Valencia, the yawning earth threw out such an immense quantity of water, that it formed a new torrent. The same phenomenon took place near Porto-Cabello.§ On the other hand, the lake of Maracaibo diminished sensibly. At Coro no commotion was felt, though the town is situated on the coast, between other towns which suffered from the earthquake. Fishermen, who

* The duration of the earthquake, that is to say the whole of the movements of undulation and rising (undulacion y trepidacion), which occasioned the horrible catastrophe of the 26th of March, 1812, was estimated by some at 50″, by others at 1′ 12″.

† As far as Villa de Los Remedios, and even to Carthagena.

‡ This is easily explained according to the system of those geologists who are of opinion that all chains of mountains, volcanic and not volcanic, have been formed by being raised up, as if through crevices.

§ It is asserted that, in the mountains of Aroa, the ground, immediately after the great shocks, was found covered with a very fine and white earth, which appeared to have been projected through crevices.

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had passed the day of the 26th of March in the island of Orchila, thirty leagues north-east of La Guayra, felt no shock. These differences in the direction and propagation of the shock, are probably owing to the peculiar position of the stony strata.

Having thus traced the effects of the earthquake to the west of Caracas, as far as the snowy mountains of Santa Martha, and the table-land of Santa Fé de Bogotá, we will proceed to consider their action on the country eastward of the capital. The commotions were very violent beyond Caurimare, in the valley of Capaya, where they extended as far as the meridian of Cape Codera: but it is extremely remarkable that they were very feeble on the coasts of Nueva Barcelona, Cumana, and Paria; though these coasts are the continuation of the shore of La Guayra, and were formerly known to have been often agitated by subterranean commotions. Admitting that the destruction of the four towns of Caracas, La Guayra, San Felipe, and Merida, may be attributed to a volcanic focus situated under or near the island of St. Vincent, we may conceive that the motion might have been propagated from north-east to south-west in a line passing through the islands of Los Hermanos, near Blanquilla, without touching the coasts of Araya, Cumana, and Nueva Barcelona. This propagation of the shock might even have taken place without any commotion having been felt at the intermediate points on the surface of the globe (the Hermanos Islands for instance). This phenomenon is frequently remarked at Peru and Mexico, in earthquakes which have followed during ages a fixed direction. The inhabitants of the Andes say, speaking of an intermediary tract of ground, not affected by the general commotion, "that it forms a bridge" (*que hace puente*): as if they mean to indicate by this expression that the undulations are propagated at an immense depth under an inert rock.

At Caracas, fifteen or eighteen hours after the great catastrophe, the earth was tranquil. The night, as has already been observed, was fine and calm; and the commotions did not recommence till after the 27th. They were then attended by a very loud and long continued subterranean noise (bramido). The inhabitants of the destroyed city wandered into the country; but the villages and farms

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having suffered as much as the town, they could find no shelter till they were beyond the mountains of los Teques, in the valleys of Aragua, and in the llanos or savannahs. No less than fifteen oscillations were felt in one day. On the 5th of April there was almost as violent an earthquake as that which overthrew the capital. During several hours the ground was in a state of perpetual undulation. Large heaps of earth fell in the mountains; and enormous masses of rock were detached from the Silla of Caracas. It was even asserted, and this opinion prevails still in the country, that the two domes of the Silla sunk fifty or sixty toises; but this statement is not founded on any measurement. I am informed that, in like manner, in the province of Quito, the people, at every period of great commotions, imagine that the volcano of Tunguragua diminishes in height. It has been affirmed, in many published accounts of the destruction of Caracas, that the mountain of the Silla is an extinguished volcano; that a great quantity of volcanic substances are found on the road from La Guayra to Caracas; that the rocks do not present any regular stratification; and that everything bears the stamp of the action of fire. It has even been stated that twelve years prior to the great catastrophe, M. Bonpland and myself had, from our own observations, considered the Silla as a very dangerous neighbour to the city of Caracas, because the mountain contained a great quantity of sulphur, and the commotions must come from the north-east. It is seldom that observers of nature have to justify themselves for an accomplished prediction; but I think it my duty to oppose ideas which are too easily adopted on the *local causes* of earthquakes.

In all places where the soil has been incessantly agitated for whole months, as at Jamaica in 1693, Lisbon in 1755, Cumana in 1766, and Piedmont in 1808, a volcano is expected to open. People forget that we must seek the focus or centre of action, far from the surface of the earth; that, according to undeniable evidence, the undulations are propagated almost at the same instant across seas of immense depth, at the distance of a thousand leagues; and that the greatest commotions take place not at the foot of active volcanos, but in chains of mountains composed of the most heterogeneous rocks. In our geognostical observation of

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the country round Caracas we found gneiss, and mica-slate containing beds of primitive limestone. The strata are scarcely more fractured or irregularly inclined than near Freyburg in Saxony, or wherever mountains of primitive formation rise abruptly to great heights. I found at Caracas neither basalt nor dorolite, nor even trachytes or trap-porphyries; nor in general any trace of an extinguished volcano, unless we choose to regard the diabases of primitive grünstein, contained in gneiss, as masses of lava, which have filled up fissures. These diabases are the same as those of Bohemia, Saxony, and Franconia;* and whatever opinion may be entertained respecting the ancient causes of the oxidation of the globe at its surface, all those primitive mountains, which contain a mixture of hornblende and feldspar, either in veins or in balls with concentric layers, will not, I presume, be called volcanic formations. Mont Blanc and Mont d'Or will not be ranged in one and the same class. Even the partisans of the Huttonian or volcanic theory make a distinction between the lavas melted under the mere pressure of the atmosphere at the surface of the globe, and those layers formed by fire beneath the immense weight of the ocean and superincumbent rocks. They would not confound Auvergne and the granitic valley of Caracas in the same denomination; that of a country of extinct volcanos.

I never could have pronounced the opinion, that the Silla and the Cerro de Avila, mountains of gneiss and mica-slate, were in dangerous proximity to the city of Caracas because they contained a great quantity of pyrites in subordinate beds of primitive limestone. But I remember having said, during my stay at Caracas, that the eastern extremity of Terra Firma appeared, since the great earthquake of Quito, in a state of agitation, which warranted apprehension that the province of Venezuela would gradually be exposed to violent commotions. I added, that when a country had been long subject to frequent shocks, new subterranean communications seemed to open with neighbouring countries; and that the volcanos of the West India Islands,

* These grünsteins are found in Bohemia, near Pilsen, in granite; in Saxony, in the mica-slates of Scheenberg; in Franconia, between Steeben and Lauenstein, in transition-slates.

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lying in the direction of the Silla, north-east of the city, were perhaps the vents, at the time of an eruption, for those elastic fluids which cause earthquakes on the coasts of the continent. These considerations, founded on local knowledge of the place, and on simple analogies, are very far from a prediction justified by the course of physical events.

On the 30th of April, 1812, whilst violent commotions were felt simultaneously in the valley of the Mississippi, in the island of St. Vincent, and in the province of Venezuela, a subterranean noise resembling frequent discharges of large cannon was heard at Caracas, at Calabozo (situated in the midst of the steppes), and on the borders of the Rio Apure, over a superficies of four thousand square leagues. This noise began at two in the morning. It was accompanied by no shock; and it is very remarkable, that it was as loud on the coast as at the distance of eighty leagues inland. It was everywhere believed to be transmitted through the air; and was so far from being thought a subterranean noise, that in several places, preparations were made for defence against an enemy, who seemed to be advancing with heavy artillery. Señor Palacio, crossing the Rio Apure below the Orivante, near the junction of the Rio Nula, was told by the inhabitants, that the firing of cannon had been heard distinctly at the western extremity of the province of Varinas, as well as at the port of La Guayra to the north of the chain of the coast.

The day on which the inhabitants of Terra Firma were alarmed by a subterranean noise was that of the great eruption of the volcano in the island of St. Vincent. That mountain, near five hundred toises high, had not thrown out lava since the year 1718. Scarcely was any smoke perceived to issue from it, when, in the month of May 1811, frequent shocks announced that the volcanic fire was either rekindled, or directed anew to that part of the West Indies. The first eruption did not take place till the 27th of April, 1812, at noon. It was merely an ejection of ashes, but attended with a tremendous noise. On the 30th, the lava overflowed the brink of the crater, and, after a course of four hours, reached the sea. The sound of the explosion is described as resembling that of alternate discharges of very large cannon and musketry; and it is worthy of re-

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mark, that it seemed much louder to persons out at sea, and at a great distance from land, than to those within sight of land, and near the burning volcano.

The distance in a straight line from the volcano of St. Vincent to the Rio Apure, near the mouth of the Nula, is two hundred and ten leagues.* The explosions were consequently heard at a distance equal to that between Vesuvius and Paris. This phenomenon, in conjunction with a great number of facts observed in the Cordilleras of the Andes, shows that the sphere of the subterranean activity of a volcano is much more extensive than we should be disposed to admit, if we judged merely from the small changes effected at the surface of the globe. The detonations heard during whole days together in the New World, eighty, one hundred, or even two hundred leagues distant from a crater, do not reach us by the propagation of the sound through the air; they are transmitted by the earth, perhaps in the very place where we happen to be. If the eruptions of the valcano of St. Vincent, Cotopaxi, or Tunguragua, resounded from afar, like a cannon of immense magnitude, the noise ought to increase in the inverse ratio of the distance: but observations prove, that this augmentation does not take place. I must further observe, that M. Bonpland and I, going from Guayaquil to the coast of Mexico, crossed latitudes in the Pacific, where the crew of our ship were dismayed by a hollow sound coming from the depth of the ocean, and transmitted by the waters. At that time a new eruption of Cotopaxi took place, but we were as far distant from the volcano, as Etna from the city of Naples. The little town of Honda, on the banks of the Magdalena, is not less than one hundred and forty-five leagues† from Cotopaxi; and yet, in the great explosions of this volcano, in 1744, a subterranean noise was heard at Honda, and supposed to be discharges of heavy artillery. The monks of San Francisco spread a report that the town of Carthagena was besieged and bombarded by the English; and the intelligence was believed throughout the country. Now

* Where the contrary is not expressly stated, nautical leagues of twenty to a degree, or two thousand eight hundred and fifty-five toises, are always to be understood.

† This is the distance from Vesuvius to Mont Blanc.

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the volcano of Cotopaxi is a cone, more than one thousand eight hundred toises above the basin of Honda, and it rises from a table-land, the elevation of which is more than one thousand five hundred toises above the valley of the Magdalena. In all the colossal mountains of Quito, of the province of los Pastos, and of Popayan, crevices and valleys without number intervene. It cannot be admitted, under these circumstances, that the noise was transmitted through the air, or over the surface of the globe, and that it came from the point at which the cone and crater of Cotapaxi are situated. It appears probable, that the more elevated part of the kingdom of Quito and the neighbouring Cordilleras, far from being a group of distinct volcanoes, constitute a single swollen mass, an enormous volcanic wall, stretching from south to north, and the crest of which presents a superficies of more than six hundred square leagues. Cotopaxi, Tunguragua, Antisana, and Pichincha, are on this same raised ground. They have different names, but they are merely separate summits of the same volcanic mass. The fire issues sometimes from one, sometimes from another of these summits. The obstructed craters appear to be extinguished volcanos; but we may presume, that, while Cotopaxi or Tunguragua have only one or two eruptions in the course of a century, the fire is not less continually active under the town of Quito, under Pichincha and Imbabura.

Advancing northward we find, between the volcano of Cotopaxi and the town of Honda, two other systems of volcanic mountains, those of los Pastos and of Popayan. The connection between these systems was manifested in the Andes by a phenomenon which I have already had occasion to notice, in speaking of the last destruction of Cumaña. In the month of November 1796 a thick column of smoke began to issue from the volcano of Pasto, west of the town of that name, and near the valley of Rio Guaytara. The mouths of the volcano are lateral, and situated on its western declivity, yet during three successive months the column of smoke rose so much higher than the ridge of the mountain that it was constantly visible to the inhabitants of the town of Pasto. They described to us their astonishment when, on the 4th of February, 1797, they observed the

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smoke disappear in an instant, whilst no shock whatever was felt. At that very moment, sixty-five leagues southward, between Chimborazo, Tunguragua, and the Altar (Capac-Urcu), the town of Riobamba was overthrown by the most terrible earthquake on record. Is it possible to doubt, from this coincidence of phenomena, that the vapours issuing from the small apertures or *ventanillas* of the volcano of Pasto had an influence on the pressure of those elastic fluids which convulsed the earth in the kingdom of Quito, and destroyed in a few minutes thirty or forty thousand inhabitants?

To explain these great effects of volcanic reactions, and to prove that the group or system of the volcanos of the West India Islands may sometimes shake the continent, I have cited the Cordillera of the Andes. Geological reasoning can be supported only by the analogy of facts which are recent, and consequently well authenticated: and in what other region of the globe could we find greater and more varied volcanic phenomena than in that double chain of mountains heaved up by fire? in that land where nature has covered every mountain and every valley with her marvels? If we consider a burning crater only as an isolated phenomenon, if we be satisfied with merely examining the mass of stony substances which it has thrown up, the volcanic action at the surface of the globe will appear neither very powerful nor very extensive. But the image of this action becomes enlarged in the mind when we study the relations which link together volcanos of the same group; for instance, those of Naples and Sicily, of the Canary Islands,* of the

* I have already observed (p. 113) that the whole group of the Canary Islands rises, as we may say, above one and the same submarine volcano. Since the sixteenth century, the fire of this volcano has burst forth alternately in Palma, Teneriffe, and Lancerote. Auvergne presents a whole system of volcanos, the action of which has now ceased; but in the middle of a system of active volcanos, for instance, in that of Quito, we must not consider as an extinguished volcano a mountain, the crater of which is obstructed, and through which the subterraneous fire has not issued for ages. Etna, the Æolian Isles, Vesuvius, and Epomeo; the peak of Teyde, Palma, and Lancerote; St. Michael, La Caldiera of Fayal, and Pico; St. Vincent, St. Lucia, and Guadaloupe; Orizava, Popocatepetl, Jorullo, and La Colima; Bombacho, the volcano of Grenada, Telica, Momotombo, Isalco, and the volcano of Guatimala;

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Azores, of the Caribbee islands of Mexico, of Guatimala, and of the table-land of Quito; when we examine either the reactions of these different systems of volcanos on one another, or the distance at which, by subterranean communication, they simultaneously convulse the earth.

The study of volcanos may be divided into two distinct branches; one, simply mineralogical, is directed to the examination of the stony strata, altered or produced by the action of fire; from the formation of the trachytes or trap-porphyries, of basalts, phonolites, and dolerites, to the most recent lavas: the other branch, less accessible and more neglected, comprehends the physical relations which link volcanos together, the influence of one volcanic system on another, the connection existing between the action of burning mountains and the commotions which agitate the earth at great distances, and during long intervals, in the same direction. This study cannot progress till the various epochs of simultaneous action, the direction, the extent, and the force of the convulsions are carefully noted; till we have attentively observed their progressive advance to regions which they had not previously reached; and the coincidence between distant volcanic eruptions and those noises which the inhabitants of the Andes very expressively term subterraneous thunders, or roarings.* All these objects are comprehended in the domain of the history of nature.

Though the narrow circle within which all certain traditions are confined, does not present any of those general revolutions which have heaved up the Cordilleras and buried myriads of pelagian animals; yet Nature, acting under our eyes, nevertheless exhibits violent though partial changes, the study of which may throw light on the most remote epochs. In the interior of the earth those mysterious powers exist, the effects of which are manifested at the surface by the production of vapours, of incandescent scoriæ, of new volcanic rocks and thermal springs, by the appearance of

Cotopaxi, Tunguragua, Pichincha, Antisana, and Sangai, belong to the same system of burning volcanos; they are generally ranged in rows, as if they had issued from a crevice, or vein not filled up; and, it is very remarkable, that their position is in some parts in the general direction of the Cordilleras, and in others in a contrary direction.

* Bramidos y truenos subterraneos.

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new islands and mountains, by commotions propagated with the rapidity of an electric shock, finally by those subterranean thunders,* heard during whole months, without shaking the earth, in regions far distant from active volcanos.

In proportion as equinoctial America shall increase in culture and population, and the system of volcanos of the central table-land of Mexico, of the Caribbee Islands, of Popayan, of los Pastos, and Quito, shall be more attentively observed, the connection of eruptions and of earthquakes, which precede and sometimes accompany those eruptions, will be more generally recognized. The volcanos just mentioned, particularly those of the Andes, which rise above the enormous height of two thousand five hundred toises, present great advantages for observation. The periods of their eruptions are singularly regular. They remain thirty or forty years without emitting scoriæ, ashes, or even vapours. I could not perceive the smallest trace of smoke on the summit of Tunguragua or Cotopaxi. A gust of vapour issuing from the crater of Mount Vesuvius scarcely attracts the attention of the inhabitants of Naples, accustomed to the movements of that little volcano, which throws out scoriæ sometimes during two or three years successively. Thence it becomes difficult to judge whether the emission of scoriæ may have been more frequent at the time when an earthquake has been felt in the Apennines. On the ridge of the Cordilleras everything assumes a more decided character. An eruption of ashes, which lasts only a few minutes, is often followed by a calm of ten years. In such circumstances it is easy to mark the periods, and to observe the coincidence of phenomena.

If, as there appears to be little reason to doubt, that the destruction of Cumana in 1797, and of Caracas in 1812, indi-

* In the town of Guanaxuato, in Mexico, these thunders lasted from the 9th of January till the 12th of February, 1784. Guanaxuato is situated forty leagues north of the volcano of Jorullo, and sixty leagues north-west of the volcano of Popocatepetl. In places nearer these two volcanos, three leagues distant from Guanaxuato, the subterranean thunders were not heard. The noise was circumscribed within a very narrow space, in the region of a primitive schist, which approaches a transition-schist, containing the richest silver mines of the known world, and on which rest trap-porphyries, slates, and diabasis (grünstein.)

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cate the influence of the volcanos of the West India Islands* on the commotions felt on the coasts of Terra Firma, it may be desirable, before we close this chapter, to take a cursory view of this Mediterranean archipelago. The volcanic islands form one-fifth of that great arc extending from the coast of Paria to the peninsula of Florida. Running from south to north, they close the Caribbean Sea on the eastern side, while the greater West India Islands appear like the remains of a group of primitive mountains, the summit of which seems to have been between Cape Abacou, Point Morant, and the Copper Mountains, in that part where the islands of St. Domingo, Cuba, and Jamaica, are nearest to each other. Considering the basin of the Atlantic as an immense valley† which separates the two continents, and where, from 20° south to 30° north, the salient angles (Brazil and Senegambia) correspond to the receding angles (the gulf of Guinea and the Caribbean Sea), we are led to think that the latter sea owes its formation to the action of currents, which, like the *current of rotation* now existing, have flowed from east to west; and have given

* The following is the series of the phenomena:—

27th of September, 1796. Eruption in the West India Islands. (Volcano of Guadaloupe).

November, 1796. The volcano of Pasto began to emit smoke.

14th of December, 1796. Destruction of Cumana.

4th of February, 1797. Destruction of Riobamba.

30th of January, 1811. Appearance of Sabrina Island, in the Azores. The island enlarged very considerably on the 15th of June, 1811.

May, 1811. Commencement of the earthquakes in the island of St. Vincent, which lasted till May 1812.

16th of December, 1811. Commencement of the commotions in the valley of the Mississippi and the Ohio, which lasted till 1813.

December, 1811. Earthquake at Caracas.

26th of March, 1811. Destruction of Caracas. Earthquakes, which continued till 1813.

30th of April, 1811. Eruption of the volcano in St. Vincent; and the same day subterranean noises at Caracas, and on the banks of the Apure.

† The valley is narrowest (300 leagues) between Cape St. Roque and Sierra Leone. Proceeding toward the north along the coasts of the New Continent, from its pyramidal extremity, or the Straits of Magellan, we imagine we recognise the effects of a repulsion directed first toward the north-east, then toward the north-west, and finally again to the north-east.

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the southern coast of Porto Rico, St. Domingo, and the island of Cuba their uniform configuration. This supposition of an oceanic irruption has been the source of two other hypotheses on the origin of the smaller West India Islands. Some geologists admit that the uninterrupted chain of islands from Trinidad to Florida exhibits the remains of an ancient chain of mountains. They connect this chain sometimes with the granite of French Guiana, sometimes with the calcareous mountains of Pari. Others, struck with the difference of geological constitution between the primitive mountains of the Greater and the volcanic cones of the Lesser Antilles, consider the latter as having risen from the bottom of the sea.

If we recollect that volcanic upheavings, when they take place through elongated crevices, usually take a straight direction, we shall find it difficult to judge from the disposition of the craters alone, whether the volcanos have belonged to the same chain, or have always been isolated. Supposing an irruption of the ocean to take place either into the eastern part of the island of Java* or into the Cordilleras of Guatemala and Nicaragua, where so many burning mountains form but one chain, that chain would be divided into several islands, and would perfectly resemble the Caribbean Archipelago. The union of primitive formations and volcanic rocks in the same range of mountain is not extraordinary; it is very distinctly seen in my geological sections of the Cordillera of the Andes. The trachytes and basalts of Popayan are separated from the system of the volcanos of Quito by the mica-slates of Almaguer; the volcanos of Quito from the trachytes of Assuay by the gneiss of Condorasta and Guasunto. There does not exist a real chain of mountains running south-east and north-west from Oyapoc to the mouths of the Orinoco, and of which the smaller West India Islands might be a northern prolongation. The granites of Guiana, as well as the hornblende-slates, which I saw near Angostura, on the banks of the Lower Orinoco, belong to the mountains of Pacaraimo and of

* Raffles, History of Java, 1817, pp. 23—28. The principal line of the volcanos of Java, on a distance of 160 leagues, runs from west to east, through the mountains of Gagak, Gedé, Tankuban-Prahu, Ungarang, Merapi, Lawu, Wilis, Arjuna, Dasar, and Tashem.

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Parime, stretching from west to east,* in the interior of the continent, and not in a direction parallel with the coast, between the mouths of the river Amazon and the Orinoco. But though we find no chain of mountains at the north-east extremity of Terra Firma, having the same direction as the archipelago of the smaller West India Islands, it does not therefore follow that the volcanic mountains of the archipelago may not have belonged originally to the continent, and formed a part of the litteral chain of Caracas and Cumana.†

In opposing the objections of some celebrated naturalists, I am far from maintaining the ancient contiguity of all the smaller West India Islands. I am rather inclined to consider them as islands heaved up by fire, and ranged in that regular line, of which we find striking examples in so many volcanic hills in Auvergne, in Mexico, and in Peru. The geological constitution of the Archipelago appears, from the little we know respecting it, to be very similar to that of the Azores and the Canary Islands. Primitive formations are nowhere seen above ground; we find only what belongs unquestionably to volcanos: feldspar-lava, dolerite, basalt, conglomerated scoriæ, tufa, and pumice-stone. Among the limestone formations we must distinguish those which are essentially subordinate to volcanic tufas‡ from

* From the cataracts of Atures towards the Essequibo River. This chain of Pacaraimo divides the waters of the Carony from those of the Rio Parime, or Rio de Aguas Blancas.

† Among many such examples which the structure of the globe displays, we shall mention only the inflexion at a right angle formed by the Higher Alps towards the maritime Alps, in Europe; and the Belour-Tagh, which joins transversely the Mouz-Tagh and the Himalaya, in Asia. Amid the prejudices which impede the progress of mineralogical geography, we may reckon, 1st, the supposition of a perfect uniformity of direction in the chains of mountains; 2nd, the hypothesis of the continuity of all chains; 3rd, the supposition that the highest summits determine the direction of a central chain; 4th, the idea that, in all places where great rivers take rise, we may suppose the existence of great table-lands, or very high mountains.

‡ We have noticed some of the above, following Von Buch, at Lancerote, and at Fortaventura, in the system of the Canary Islands. Among the smaller islands of the West Indies, the following islets are entirely calcareous, according to M. Cortès: Mariegalante, La Desirade, the Grande Terre of Guadaloupe, and the Grenadillas. According to the observations of that naturalist, Curaçoa and Buenos Ayres present only

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those which appear to be the work of madrepores and other zoophytes. The latter, according to M. Moreau de Jonnès, seem to lie on shoals of a volcanic nature. Those mountains, which present traces of the action of fire more or less recent, and some of which reach nearly nine hundred toises of elevation, are all situated on the western skirt of the smaller West India Islands.* Each island is not the effect of one single heaving-up: most of them appear to consist of isolated masses which have been progressively united together. The matter has not been emitted from one crater, but from several; so that a single island of small extent contains a whole system of volcanos, regions purely basaltic, and others covered with recent lavas. The volcanos still burning are those of St. Vincent, St. Lucia, and Guadaloupe. The first threw out lava in 1718 and 1812; in the second there is a continual formation of sulphur by the condensation of vapours, which issue from the crevices of an ancient crater. The last eruption of the volcano of Guadaloupe took place in 1797. The Solfatara of St. Christopher's was still burning in 1692. At Martinique, Vauclin, Montagne Pelée, and the crater surrounded by the five Paps of Carbet, must be considered as three extinguished volcanos. The effects of thunder have been often confounded in that place with subterranean fire. No good observation has confirmed the supposed eruption of the 22nd of January,

calcareous formations. M. Cortès divides the West India Islands into, 1st, those containing at once primitive, secondary, and volcanic formations, like the greater islands; 2nd, those entirely calcareous, (or at least so considered) as Mariegalante and Curaçoa; 3rd, those at once volcanic and calcareous, as Antigua, St. Bartholomew, St. Martin, and St. Thomas; 4th, those which have volcanic rocks only, as St. Vincent, St. Lucia, and St. Eustache.

* Journal des Mines, tom. iii. p. 59. In order to exhibit in one point of view the whole system of the volcanos of the smaller West India Islands, I will here trace the direction of the islands from south to north.—Grenada, an ancient crater, filled with water; boiling springs; basalts between St. George and Goave.—St. Vincent, a burning volcano.—St. Lucia, a very active solfatara, named Oualibou, two or three hundred toises high; jets of hot water, by which small basins are periodically filled.—Martinique, three great extinguished volcanos; Vauclin, the Paps of Carbet, which are perhaps the most elevated summits of the smaller islands, and Montagne Pelée. (The height of this last mountain is probably 800 toises; according to Leblond it is 670 toises; according

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1792. The group of volcanos in the Caribbee Islands resembles that of the volcanos of Quito and Los Pastos; craters with which the subterranean fire does not appear to communicate are ranged on the same line with burning craters, and alternate with them.

Notwithstanding the intimate connection manifested in the action of the volcanos of the smaller West India Islands and the earthquakes of Terra Firma, it often happens that shocks felt in the volcanic archipelago are not propagated to the island of Trinidad, or to the coasts of Caracas and Cumana. This phenomenon is in no way surprising: even in the Caribbees the commotions are often confined to one place. The great eruption of the volcano in St. Vincent's did not occasion an earthquake at Martinique or Guadaloupe. Loud explosions were heard there as well as at Venezuela, but the ground was not convulsed.

These explosions must not be confounded with the rolling noise which everywhere precedes the slightest commotions; they are often heard on the banks of the Orinoco, and (as we were assured by persons living on the spot) between the Rio Arauca and Cuchivero. Father Morello relates that at the Mission of Cabruta the subterranean noise so much resembles discharges of small cannon (pedreros) that it has seemed as if a battle were being fought at a distance. On the 21st of October, 1766, the day of the terrible earthquake which desolated the province of New Andalusia, the ground was simultaneously shaken at Cumana, at Caracas, at Maracaybo, and on the banks of the Casanare, the Meta, the Orinoco, and the Ventuario. Father Gili has described

to Dupuget, 736 toises. Between Vauclin and the feldspar-lavas of the Paps of Carbet is found, as M. Moreau de Jonnès asserts, in a neck of land, a region of early basalt called La Roche Carrée). Thermal waters of Prêcheur and Lameutin.—Dominica, completely volcanic.—Guadaloupe, an active volcano, the height of which, according to Leboucher, is 799 toises; according to Amie, 850 toises.—Montserrat, a solfatara; fine porphyritic lavas with large crystals of feldspar and hornblende near Galloway, according to Mr. Nugent.—Nevis, a solfatara.—St. Christopher's, a solfatara at Mount Misery.—St. Eustache, a crater of an extinguished volcano, surrounded by pumice-stone. (Trinidad, which is traversed by a chain of primitive slate, appears to have anciently formed a part of the littoral chain of Cumana, and not of the system of the mountains of the Caribbee Islands.)

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these commotions at the Mission of Encaramada, a country entirely granitic, where they were accompanied by loud explosions. Great fallings-in of the earth took place in the mountain Paurari, and near the rock Aravacoto a small island disappeared in the Orinoco. The undulatory motion continued during a whole hour. This seemed the first signal of those violent commotions which shook the coasts of Cumana and Cariaco for more than ten months. It might be supposed that men living in woods, with no other shelter than huts of reeds and palm-leaves, could have little to dread from earthquakes. But at Erevato and Caura, where these phenomena are of rare occurrence, they terrify the Indians, frighten the beasts of the forests, and impel the crocodiles to quit the waters for the shore. Nearer the sea, where shocks are frequent, far from being dreaded by the inhabitants, they are regarded with satisfaction as the prognostics of a wet and fertile year.

In this dissertation on the earthquakes of Terra Firma and on the volcanos of the neighbouring archipelago of the West India Islands, I have pursued the plan of first relating a number of particular facts, and then considering them in one general point of view. Everything announces in the interior of the globe the operation of active powers, which, by mutual reaction, balance and modify one another. The greater our ignorance of the causes of these undulatory movements, these evolutions of heat, these formations of elastic fluids, the more it becomes the duty of persons who apply themselves to the study of physical science to examine the relations which these phenomena so uniformly present at great distances apart. It is only by considering these various relations under a general point of view, and tracing them over a great extent of the surface of the globe, through formations of rocks the most different, that we are led to abandon the supposition of trifling local causes, strata of pyrites, or of ignited coal.*

The following is the series of phenomena remarked on the northern coasts of Cumana, Nueva Barcelona, and Caracas; and presumed to be connected with the causes which pro-

* See "Views of Nature,"—On the structure and action of volcanos in different parts of the world,—p. 353 (Bohn's ed.); also "Cosmos," pp. 199—225 (Bohn's ed.).

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duce earthquakes and eruptions of lava. We shall begin with the most eastern extremity, the island of Trinidad; which seems rather to belong to the shore of the continent than to the system of the mountains of the West India Islands.

I. The pit which throws up asphaltum in the bay of Mayaro, on the eastern coast of the island of Trinidad, southward of Point Guataro. This is the mine of chapapote or mineral tar of the country. I was assured that in the months of March and June the eruptions are often attended with violent explosions, smoke, and flames. Almost on the same parallel, and also in the sea, but westward of the island (near Punta de la Brea, and to the south of the port of Naparaimo), we find a similar vent. On the neighbouring coast, in a clayey ground, appears the celebrated lake of asphaltum (Laguna de la Brea), a marsh, the waters of which have the same temperature as the atmosphere. The small cones situated at the south-western extremity of the island, between Point Icacos and the Rio Erin, appear to have some analogy with the volcanos of air and mud which I met with at Turbaco in the kingdom of New Grenada. I mention these situations of asphaltum on account of the remarkable circumstances peculiar to them in these regions; for I am not unaware that naphtha, petroleum, and asphaltum are found equally in volcanic and secondary regions,* and even more frequently in the latter. Petroleum is found floating on the sea thirty leagues north of Trinidad, around the island of Grenada, which contains an extinguished crater and basalts.

II. Hot Springs of Irapa, at the north-eastern extremity of New Andalusia, between Rio Caribe, Soro, and Yaguarapayo.

III. Air-volcano, or *Salce*, of Cumacatar, to the south of San Jose and Carupano, near the northern coast of the continent, between La Montaña de Paria and the town of Cariaco. Almost constant explosions are felt in a clayey

* The inflammable emanations of Pietra Mala, (consisting of hydrogen gas containing naphtha in a state of suspension) issue from the Alpine limestone, which may be traced from Covigliano to Raticofa, and which lies on ancient sandstone near Scarica l'Asino. Under this sandstone (old red sandstone) we find black transition limestone and the grauwacke (quartzose psammite) of Florence.

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soil, which is affirmed to be impregnated with sulphur. Hot sulphureous waters gush out with such violence that the ground is agitated by very sensible shocks. It is said that flames have been frequently seen issuing out since the great earthquake of 1797. These facts are well worthy of being examined.

IV. Petroleum-spring of the Buen Pastor, near Rio Areo. Large masses of sulphur have been found in clayey soils at Guayuta, as in the valley of San Bonifacio, and near the junction of the Rio Pao with the Orinoco.

V. The Hot Waters (Aguas Calientes) south of the Rio Azul, and the Hollow Ground of Cariaco, which, at the time of the great earthquake of Cumana, threw up sulphuretted water and viscous petroleum.

VI. Hot waters of the gulf of Cariaco.

VII. Petroleum-spring in the same gulf, near Maniquarez. It issues from mica-slate.

VIII. Flames issuing from the earth, near Cumana, on the banks of the Manzanares, and at Mariguitar, on the southern coast of the gulf of Cariaco, at the time of the great earthquake of 1797.

IX. Igneous phenomena of the mountain of Cuchivano, near Cumanacoa.

X. Petroleum-spring gushing from a shoal to the north of the Caracas Islands. The smell of this spring warns ships of the danger of this shoal, on which there is only one fathom of water.

XI. Thermal springs of the mountain of the Brigantine, near Nueva Barcelona. Temperature 43·2° (centigrade).

XII. Thermal springs of Provisor, near San Diego, in the province of New Barcelona.

XIII. Thermal springs of Onoto, between Turmero and Maracay, in the valleys of Aragua, west of Caracas.

XIV. Thermal springs of Mariara, in the same valleys. Temperature 58·9°.

XV. Thermal springs of Las Trincheras, between Porto Cabello and Valencia, issuing from granite like those of Mariara, and forming a river of warm water (Rio de Aguas Calientes). Temperature 90·4°.

XVI. Boiling springs of the Sierra Nevada of Merida.

XVII. Aperture of Mena, on the borders of Lake Mara-

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caybo. It throws up asphaltum, and is said to emit gaseous emanations, which ignite spontaneously, and are seen at a great distance.

These are the springs of petroleum and of thermal waters, the igneous meteors, and the ejections of muddy substances attended with explosions, of which I acquired a knowledge in the vast provinces of Venezuela, whilst travelling over a space of two hundred leagues from east to west. These various phenomena have occasioned great excitement among the inhabitants since the catastrophes of 1797 and 1812: yet they present nothing which constitutes a volcano, in the sense hitherto attributed to that word. If the apertures, which throw up vapours and water with violent noise, be sometimes called *volcancitos*, it is only by such of the inhabitants as persuade themselves that volcanos must necessarily exist in countries so frequently exposed to earthquakes. Advancing from the burning crater of St. Vincent in the directions of south, west and south-west, first by the chain of the Caribbee Islands, then by the littoral chain of Cumana and Venezuela, and finally by the Cordilleras of New Grenada, along a distance of three hundred and eighty leagues, we find no active volcano before we arrive at Purace, near Popayan. The total absence of apertures, through which melted substances can issue, in that part of the continent, which stretches eastward of the Cordillera of the Andes, and eastward of the Rocky Mountains, is a most remarkable geological fact.

In this chapter we have examined the great commotions which from time to time convulse the stony crust of the globe, and scatter desolation in regions favoured by the most precious gifts of nature. An uninterrupted calm prevails in the upper atmosphere; but, to use an expression of Franklin, more ingenious than accurate, thunder often rolls in the *subterranean atmosphere*, amidst that mixture of elastic fluids, the impetuous movements of which are frequently felt at the surface of the earth. The destruction of so many populous cities presents a picture of the greatest calamities which afflict mankind. A people struggling for independence are suddenly exposed to the want of subsistence, and of all the necessaries of life. Famished and without shelter, the inhabitants are dispersed through the

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country, and numbers who have escaped from the ruin of their dwellings are swept away by disease. Far from strengthening mutual confidence among the citizens, the feeling of misfortune destroys it; physical calamities augment civil discord; nor does the aspect of a country bathed in tears and blood appease the fury of the victorious party.

After the recital of so many calamities, the mind is soothed by turning to consolatory remembrances. When the great catastrophe of Caracas was known in the United States, the Congress, assembled at Washington, unanimously decreed that five ships laden with flour should be sent to the coast of Venezuela; their cargoes to be distributed among the most needy of the inhabitants. The generous contribution was received with the warmest gratitude; and this solemn act of a free people, this mark of national interest, of which the advanced civilization of the Old World affords but few examples, seemed to be a valuable pledge of the mutual sympathy which ought for ever to unite the nations of North and South America.

Chapter XV.

Departure from Caracas.—Mountains of San Pedro and of Los Teques.—La Victoria.—Valleys of Aragua.

To take the shortest road from Caracas to the banks of the Orinoco, we should have crossed the southern chain of mountains between Baruta, Salamanca, and the savannahs of Ocumare, passed over the steppes or llanos of Orituco, and embarked at Cabruta, near the mouth of the Rio Guarico. But this direct route would have deprived us of the opportunity of surveying the valleys of Aragua, which are the finest and most cultivated portion of the province; of taking the level of an important part of the chain of the coast by means of the barometer; and of descending the Rio Apure as far as its junction with the Orinoco. A traveller who has the intention of studying the configuration and natural productions of a country is not guided by

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distances, but by the peculiar interest attached to the regions he may traverse. This powerful motive led us to the mountains of Los Teques, to the hot springs of Mariara, to the fertile banks of the lake of Valencia, and through the immense savannahs of Calabozo to San Fernando de Apure, in the eastern part of the province of Varinas. Having determined on this route, our first direction was westward, then southward, and finally to east-south-east, so that we might enter the Orinoco by the Apure in latitude 7° 36′ 23″.

On the day on which we quitted the capital of Venezuela, we reached the foot of the woody mountains which close the valley on the south-west. There we halted for the night, and on the following day we proceeded along the right bank of the Rio Guayra as far as the village of Antimano, by a very fine road, partly scooped out of the rock. We passed by La Vega and Carapa. The church of La Vega rises very picturesquely above a range of hills covered with thick vegetation. Scattered houses surrounded with date-trees seem to denote the comfort of their inhabitants. A chain of low mountains separates the little river Guayra from the valley of La Pascua* (so celebrated in the history of the country), and from the ancient gold-mines of Baruta and Oripoto. Ascending in the direction of Carapa, we enjoy once more the sight of the Silla, which appears like an immense dome with a cliff on the side next the sea. This rounded summit, and the ridge of Galipano crenated like a wall, are the only objects which in this basin of gneiss and mica-slate impress a peculiar character on the landscape. The other mountains have a uniform and monotonous aspect.

A little before reaching the village of Antimano we observed on the right a very curious geological phenomenon. In hollowing the new road out of the rock, two large veins of gneiss were discovered in the mica-slate. They are nearly perpendicular, intersecting all the mica-slate strata, and are

* Valley of Cortes, or Easter Valley, so called because Diego de Losada, after having defeated the Teques Indians, and their cacique Guaycaypuro, in the mountains of San Pedro, spent the Easter there in 1567, before entering the valley of San Francisco. In the latter place he founded the city of Caracas.

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from six to eight toises thick. These veins contain not fragments, but balls or spheres of granular diabasis,* formed of concentric layers. These balls are composed of lamellar feldspar and hornblende closely commingled. The feldspar approximates sometimes to vitreous feldspar when disseminated in very thin laminæ in a mass of granular diabasis, decomposed, and emitting a strong argillaceous smell. The diameter of the spheres is very unequal, sometimes four or eight inches, sometimes three or four feet; their nucleus, which is more dense, is without concentric layers, and of a very dark green hue, inclining to black. I could not perceive any mica in them; but, what is very remarkable, I found great quantities of disseminated garnets. These garnets are of a very fine red, and are found in the grünstein only. They are neither in the gneiss, which serves as a cement to the balls, nor in the mica-slate, which the veins traverse. The gneiss, the constituent parts of which are in a state of considerable disintegration, contains large crystals of feldspar; and, though it forms the body of the vein in the mica-slate, it is itself traversed by threads of quartz two inches thick, and of very recent formation. The aspect of this phenomenon is very curious: it appears as if cannon-balls were embedded in a wall of rock. I also thought I recognized in these same regions, in the Montaña de Avila, and at Cabo Blanco, east of La Guayra, a granular diabasis, mixed with a small quantity of quartz and pyrites, and destitute of garnets, not in veins, but in subordinate strata in the mica-slate. This position is unquestionably to be found in Europe in primitive mountains; but in general the granular diabasis is more frequently connected with the system of transition rocks, especially with a schist (übergangs-thonschiefer) abounding in beds of Lydian stone strongly carburetted, of schistose jasper,† ampelites,‡ and black limestone.

Near Antimano all the orchards were full of peach-trees loaded with blossom. This village, the Valle, and the banks of the Macarao, furnish great abundance of peaches, quinces,

* Ur-grünstein. I remember having seen similar balls filling a vein in transition-slate, near the castle of Schauenstein in the margravate of Bayreuth. I sent several balls from Antimano to the collection of the king of Spain at Madrid.

† Kieselschiefer. ‡ Alaunschiefer.

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and other European fruits for the market of Caracas. Between Antimano and Ajuntas we crossed the Rio Guayra seventeen times. The road is very fatiguing; yet, instead of making a new one, it would perhaps be better to change the bed of the river, which loses a great quantity of water by the combined effects of filtration and evaporation. Each sinuosity forms a marsh more or less extensive. This loss of water is to be regretted in a province, nearly all the cultivated portions of which are extremely dry. The rains are much less frequent and less violent in this place than in the interior of New Andalusia, at Cumanacoa, and on the banks of the Guarapiche. Many of the mountains of Caracas enter the region of the clouds; but the strata of primitive rocks dip at an angle of 70° or 80°, and generally to northwest, so that the waters are either lost in the interior of the earth, or gush out in copious springs not southward but northward of the mountains of the coast of Niguatar, Avila, and Mariara. The rising of the gneiss and mica-slate strata to the south appears to me to explain in a considerable degree the extreme humidity of the coast. In the interior of the province we meet with portions of land, two or three leagues square, in which there are no springs; consequently sugar-cane, indigo, and coffee, grow only in places where running waters can be made to supply artificial irrigation during very dry weather. The early colonists imprudently destroyed the forests. Evaporation is enormous on a stony soil surrounded with rocks, which radiate heat on every side. The mountains of the coast, like a wall, extending east and west from Cape Codera toward Point Tucacas, prevent the humid air of the shore (that is to say, those inferior strata of the atmosphere resting immediately on the sea, and dissolving the largest proportion of water) from penetrating to the islands. There are few openings, few ravines, which, like those of Catia or of Tipe, lead from the coast to the high longitudinal valleys, and there is no bed of a great river, no gulf allowing the sea to flow inland, spreading moisture by abundant evaporation. In the eighth and tenth degrees of latitude, in regions where the clouds do not, as it were, skim the surface of the soil, many trees are stripped of their leaves in the months of January and February; not by the sinking of the temperature as in

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Europe, but because the air at this period, the most distant from the rainy season, nearly attains its maximum of dryness. Only those plants which have very tough and glossy leaves resist this absence of humidity. Beneath the fine sky of the tropics the traveller is struck with the almost hibernal aspect of the country; but the freshest verdure again appears when he reaches the banks of the Orinoco, where another climate prevails; and the great forests preserve by their shade a certain quantity of moisture in the soil, by sheltering it from the devouring heat of the sun.

Beyond the small village of Antimano the valley becomes much narrower. The river is bordered with *Lata*, a fine gramineous plant with distich leaves, which sometimes reaches the height of thirty feet.* Every hut is surrounded with enormous trees of persea,† at the foot of which the aristolochiæ, paullinia, and other creepers vegetate. The neighbouring mountains, covered with forests, seem to spread humidity over the western extremity of the valley of Caracas. We passed the night before our arrival at Las Ajuntas at a sugar-cane plantation. A square house (the hacienda or farm of Don Fernando Key-Muñoz) contained nearly eighty negroes; they were lying on skins of oxen spread upon the ground. In each apartment of the house were four slaves: it looked like a barrack. A dozen fires were burning in the farm-yard, where people were employed in dressing food, and the noisy mirth of the blacks almost prevented us from sleeping. The clouds hindered me from observing the stars; the moon appeared only at intervals. The aspect of the landscape was dull and uniform, and all the surrounding hills were covered with aloes. Workmen were employed at a small canal, intended for conveying the waters of the Rio San Pedro to the farm, at a height of more than seventy feet. According to a barometric calculation, the site of the hacienda is only fifty toises above the bed of the Rio Guayra at La Noria, near Caracas.

The soil of these countries is found to be but little favourable to the cultivation of the coffee-tree, which in general is less productive in the valley of Caracas than was imagined

* G. saccharoides.

† Laurus persea (alligator pear).

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when the first plantations were made near Chacao. The finest coffee-plantations are now found in the savannah of Ocumare, near Salamanca, and at Rincon, in the mountainous countries of Los Mariches, San Antonio Hatillo, and Los Budares. The coffee of the three last mentioned places, situated eastward of Caracas, is of a superior quality; but the trees bear a smaller quantity, which is attributed to the height of the spot and the coolness of the climate. The greater plantations of the province of Venezuela (as Aguacates, near Valencia and Rincon) yield in good years a produce of three thousand quintals.

The extreme predilection entertained in this province for the culture of the coffee-tree is partly founded on the circumstance that the berry can be preserved during a great number of years; whereas, notwithstanding every possible care, cacao spoils in the warehouses after ten or twelve months. During the long dissensions of the European powers, at a time when Spain was too weak to protect the commerce of her colonies, industry was directed in preference to productions of which the sale was less urgent, and could await the chances of political and commercial events. I remarked that in the coffee-plantations the nurseries are formed not so much by collecting together young plants, accidentally rising under trees which have yielded a crop, as by exposing the seeds of coffee to germination during five days, in heaps, between plantain leaves. These seeds are taken out of the pulp, but yet retaining a part of it adherent to them. When the seed has germinated it is sown, and it produces plants capable of bearing the heat of the sun better than those which spring up in the shade in coffee-plantations. In this country five thousand three hundred coffee-trees are generally planted in a *fanega* of ground, amounting to five thousand four hundred and seventy-six square toises. This land, if it be capable of artificial irrigation, costs five hundred piastres in the northern part of the province. The coffee-tree flowers only in the second year, and its flowering lasts only twenty-four hours. At this time the shrub has a charming appearance; and, when seen from afar, it appears covered with snow. The produce of the third year becomes very abundant. In plantations well weeded and watered, and recently culti-

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vated, trees will bear sixteen, eighteen, and even twenty pounds of coffee. In general, however, more than a pound and a half or two pounds cannot be expected from each plant; and even this is superior to the mean produce of the West India Islands. The coffee trees suffer much from rain at the time of flowering, as well as from the want of water for artificial irrigation, and also from a parasitic plant, a new species of loranthus, which clings to the branches. When, in plantations of eighty or a hundred thousand shrubs, we consider the immense quantity of organic matter contained in the pulpy berry of the coffee-tree, we may be astonished that no attempts have been made to extract a spirituous liquor from them.*

If the troubles of St. Domingo, the temporary rise in the price of colonial produce, and the emigration of French planters, were the first causes of the establishment of coffee-plantations on the continent of America, in the island of Cuba, and in Jamaica; their produce has far more than compensated the deficiency of the exportation from the French West India Islands. This produce has augmented in proportion to the population, the change of customs, and the increasing luxury of the nations of Europe. The island

* The berries heaped together produce a vinous fermentation, during which a very pleasant alcoholic smell is emitted. Placing, at Caracas, the ripe fruit of the coffee-tree under an inverted jar, quite filled with water, and exposed to the rays of the sun, I remarked that no extrication of gas took place in the first twenty-four hours. After thirty-six hours the berries became brown, and yielded gas. A thermometer, enclosed in the jar in contact with the fruit, kept at night 4° or 5° higher than the external air. In the space of eighty-seven hours, sixty berries, under various jars, yielded me from thirty-eight to forty cubic inches of a gas, which underwent no sensible diminution with nitrous gas. Though a great quantity of carbonic acid had been absorbed by the water as it was produced, I still found 0·78 in the forty inches. The remainder, or 0·22, was nitrogen. The carbonic acid had not been formed by the absorption of the atmospheric oxygen. That which is evolved from the berries of the coffee-tree slightly moistened, and placed in a phial with a glass stopple filled with air, contains alcohol in suspension; like the foul air which is formed in our cellars during the fermentation of must. On agitating the gas in contact with water, the latter acquires a decidedly alcoholic flavour. How many substances are perhaps contained in a state of suspension in those mixtures of carbonic acid and hydrogen, which are called deleterious miasmata, and which rise everywhere within the tropics, in marshy grounds, on the sea-shore, and in forests where the soil is strewed with dead leaves, rotten fruits, and putrefying insects.

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of St. Domingo exported, in 1700, at the time of Necker's administration, nearly seventy-six million pounds of coffee.*

Tea could be cultivated as well as coffee in the mountainous parts of the provinces of Caracas and Cumana. Every climate is there found rising in stages one above another; and this new culture would succeed there as well as in the southern hemisphere, where the government of Brazil, protecting at the same time industry and religious toleration, suffered at once the introduction of Chinese tea and of the dogmas of Fo. It is not yet a century since the first coffee-trees were planted at Surinam and in the West India Islands, and already the produce of America amounts to fifteen millions of piastres, reckoning the quintal of coffee at fourteen piastres only.

On the eighth of February we set out at sunrise, to cross the Higuerote, a group of lofty mountains, separating the two longitudinal valleys of Caracas and Aragua. After passing, near Las Ajuntas, the junction of the two small rivers San Pedro and Macarao, which form the Rio Guayra, we ascended a steep hill to the table-land of La Buenavista, where we saw a few lonely houses. The view extends on the north-west to the city of Caracas, and on the south to the village of Los Teques. The country has a very wild aspect, and is thickly wooded. We had now gradually lost the plants of the valley of Caracas.† We were eight hun-

* French pounds, containing 9216 grains. 112 English pounds = 105 French pounds; and 160 Spanish pounds = 93 French pounds. The island of St. Domingo was at that time, it must be remembered, a French colony.

† The Flora of Caracas is characterized chiefly by the following plants, which grow between the heights of four hundred and six hundred toises. Cipura martinicensis, Panicum mieranthum, Parthenium hysterophorus, Vernonia odoratissima, (Pevetera, with flowers having a delicious odour of heliotropium), Tagetes caracasana, T. scoparia of Lagasca (introduced by M. Bonpland into the gardens of Spain), Croton hispidus, Smilax scabriusculus, Limnocharis Humboldti, Rich., Equisetum ramosissimum, Heteranthera alismoïdes, Glycine punctata, Hyptis Plumeri, Pavonia cancellata, Cav., Spermacoce rigida, Crotalaria acutifolia, Polygala nemorosa, Stachytarpheta mutabilis, Cardiospermum ulmaceum, Amaranthus caracasanus, Elephantopus strigosus, Hydrolea mollis, Alternanthera caracasana, Eupatorium amydalinum, Elytraria fasciculata, Salvia fimbriata, Angelonia salicaria, Heliotropium strictum, Convolvolus batatilla, Rubus jamaicensis, Datura arborea, Dalea enneaphylla, Buchnera rosea, Salix Humboldtiana; Willd., Theophrasta longifolia, Tournefortia cara-

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dred and thirty-five toises above the level of the ocean, which is almost the height of Popayan; but the mean temperature of this place is probably only 17° or 18°. The road over these mountains is much frequented; we met continually long files of mules and oxen; it is the great road leading from the capital to La Victoria, and the valleys of Aragua. This road is cut out of a talcose gneiss* in a state of decomposition. A clayey soil mixed with spangles of mica covered the rock, to the depth of three feet. Travellers suffer from the dust in winter, while in the rainy season the place is changed into a slough. On descending the table-land of Buenavista, about fifty toises to the south-east, an abundant spring, gushing from the gneiss, forms several cascades surrounded with thick vegetation. The path leading to the spring is so steep that we could touch with our hands the tops of the arborescent ferns, the trunks of which reach a height of more than twenty-five feet. The surrounding rocks are covered with jungermannias and hypnoid mosses. The torrent, formed by the spring, and shaded with heliconias, uncovers, as it falls, the roots of the plumerias,† cupeys,‡ browneas, and Ficus gigantea. This humid spot, though

casana, Inga cinerea, I. ligustrina, I. sapindioIdes, I. fastuosa, Schwenkia patens, Erythrina mitis. The most agreeable places for herborizing near Caracas are the ravines of Tacagua, Tipe, Cotecita, Catoche, Anauco, and Chacaito.

* The direction of the strata of gneiss varies; it is either hor. 3·4, dipping to the N.W. or hor. 8·2, dipping to the S.E.

† The red jasmine-tree, *frangipanier* of the French West India Islands. The plumeria, so common in the gardens of the Indians, has been very seldom found in a wild state. It is mixed here with the Piper flagellare, the spadix of which sometimes reaches three feet long. With the new kind of fig-tree (which we have called Ficus gigantea, because it frequently attains the height of a hundred feet), we find in the mountains of Buenavista and of Los Teques, the Ficus nymphæifolia of the garden of Schönbrunn, introduced into our hot-houses by M. Bredemeyer. I am certain of the identity of the species found in the same places; but I doubt really whether it be really the F. nymphæifolia of Linnæus, which is supposed to be a native of the East Indies.

‡ In the experiments I made at Caracas, on the air which circulates in plants, I was struck with the fine appearance presented by the petioles and leaves of the Clusia rosea, when cut open under water, and exposed to the rays of the sun. Each trachea gives out a current of gas, purer by 0·08 than atmospheric air. The phenomenon ceases the moment the apparatus is placed in the shade. There is only a very slight disengage-

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infested by serpents, presents a rich harvest to the botanist. The Brownea, which the inhabitants call *rosa del monte*, or *palo de cruz*, bears four or five hundred purple flowers together in one thyrsus; each flower has invariably eleven stamina, and this majestic plant, the trunk of which grows to the height of fifty or sixty feet, is becoming rare, because its wood yields a highly valued charcoal. The soil is covered with pines (ananas), hemimeris, polygala, and melastomas. A climbing gramen* with its light festoons unites trees, the presence of which attests the coolness of the climate of these mountains. Such are the Aralia capitata,† the Vismia caparosa, and the Clethra fagifolia. Among these plants, peculiar to the fine region of the arborescent ferns,‡ some palm-trees rise in the openings, and some scattered groups of *guarumo*, or cecropia with silvery leaves. The trunks of the latter are not very thick, and are of a black colour towards the summit, as if burnt by the oxygen of the atmosphere. We are surprised to find so noble a tree, which has the port of the theophrasta and the palm-tree, bearing generally only eight or ten terminal leaves. The ants, which inhabit the trunk of the *guarumo*, or *jarumo*, and destroy its interior cells, seem to impede its growth. We had already made one herborization in the temperate mountains of the Higuerote in the month of December, accompanying the capitan-general, Señor de Guevara, in an excursion with the intendant of the province to the Valles de Aragua. M. Bonpland then found in the thickest part of the forest some plants of *aguatire*, the wood of which, celebrated for its fine red colour, will probably one day become an article of exportation to Europe. It is the Sickingia erythroxylon described by Bredemeyer and Willdenow.

ment of air at the two surfaces of the leaves of the clusia exposed to the sun without being cut open. The gas enclosed in the capsules of the Cardiospermum vesicarium appeared to me to contain the same proportion of oxygen as the atmosphere, while that contained between the knots, in the hollow of the stalk, is generally less pure, containing only from 0·12 to 0·15 of oxygen. It is necessary to distinguish between the air circulating in the tracheæ, and that which is stagnant in the great cavities of the stems and pericarps.

* *Carice.* See p. 207.

† *Candelero.* We found it also at La Cumbre, at a height of 700 toises.

‡ Called by the inhabitants of the country 'Region de los helechos.'

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Descending the woody mountain of the Higuerote to the south-west, we reached the small village of San Pedro, situated in a basin where several valleys meet, and almost three hundred toises lower than the table-land of Buenavista. Plantain-trees, potatoes,* and coffee are cultivated together on this spot. The village is very small, and the church not yet finished. We met at an inn (pulperia) several European Spaniards employed at the government tobacco farm. Their dissatisfaction formed a strange contrast to our feelings. They were fatigued with their journey, and they vented their displeasure in complaints and maledictions on the wretched country, or to use their own phrase, *estas tierras infelices*, in which they were doomed to live. We, on the other hand, were enchanted with the wild scenery, the fertility of the soil, and the mildness of the climate. Near San Pedro, the talcose gneiss of Buenavista passes into a mica-slate filled with garnets, and containing subordinate beds of serpentine. Something analogous to this is met with at Zöblitz in Saxony. The serpentine, which is very pure and of a fine green, varied with spots of a lighter tint, often appears only superimposed on the mica-slate. I found in it a few garnets, but no metalloid diallage.

The valley of San Pedro, through which flows the river of the same name, separates two great masses of mountains, the Higuerote and Las Cocuyzas. We ascended westward in the direction of the small farms of Las Lagunetos and Garavatos. These are solitary houses, which serve as inns, and where the mule-drivers obtain their favourite beverage, the *guarapo*, or fermented juice of the sugar-cane: intoxication is very common among the Indians who frequent this road. Near Garavatos there is a mica-slate rock of singular form; it is a ridge, or steep wall, crowned by a tower. We opened the barometer at the highest point of the mountain Las Cocuyzas,† and found ourselves almost at the same elevation as on the table-land of Buenavista, which is scarcely ten toises higher.

The prospect at Las Lagunetas is extensive, but rather uniform. This mountainous and uncultivated tract of ground

* Solanum tuberosum.

† Absolute height 845 toises.

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between the sources of the Guayra and the Tuy is more than twenty-five square leagues in extent. We there found only one miserable village, that of Los Teques, south-east of San Pedro. The soil is as it were furrowed by a multitude of valleys, the smallest of which, parallel with each other, terminate at right angles in the largest valleys. The back of the mountains presents an aspect as monotonous as the ravines; it has no pyramidal forms, no ridges, no steep declivities. I am inclined to think that the undulation of this ground, which is for the most part very gentle, is less owing to the nature of the rocks, (to the decomposition of the gneiss for instance), than to the long presence of the water and the action of currents. The limestone mountains of Cumana present the same phenomenon north of Tumiriquiri.

From Las Lagunetas we descended into the valley of the Rio Tuy. This western slope of the mountains of Los Teques bears the name of Las Cocuyzas, and it is covered with two plants with agave leaves; the *maguey of Cocuyza*, and the *maguey of Cocuy*. The latter belongs to the genus Yucca.* Its sweet and fermented juice yields a spirit by distillation; and I have seen the young leaves of this plant eaten. The fibres of the full-grown leaves furnish cords of extraordinary strength.† Leaving the mountains of the Higuerote and Los Teques, we entered a highly cultivated country, covered with hamlets and villages; several of which would in Europe be called towns. From east to west, on a line of twelve leagues in extent, we passed La Victoria, San Mateo, Turmero, and Maracay, containing together more than 28,000 inhabitants. The plains of the Tuy may be considered as the eastern extremity of the valleys of Aragua, extending from Guigne, on the borders of the lake of Valencia, as far as the foot of Las Cocuyzas. A barometrical measurement gave me 295 toises for the absolute height of the Valle del Tuy, near the farm of Manterola, and 222 toises for that of the surface of the lake. The Rio Tuy, flowing from the mountains of Las Cocuyzas, runs first towards the west, then turning to the south and to the east,

* Yucca acaulis, Humb.

† At the clock of the cathedral of Caracas, a cord of maguey, half an inch in diameter, sustained for fifteen years a weight of 350 pounds.

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it takes its course along the high savannahs of Ocumare, receives the waters of the valley of Caracas, and reaches the sea near cape Codera. It is the small portion of its basin in the westward direction which, geologically speaking, would seem to belong to the valley of Aragua, if the hills of calcareous tufa, breaking the continuity of these valleys between Consejo and La Victoria, did not deserve some consideration. We shall here again remind the reader that the group of the mountains of Los Teques, eight hundred and fifty toises high, separates two longitudinal valleys, formed in gneiss, granite, and mica-slate. The most eastern of these valleys, containing the capital of Caracas, is 200 toises higher than the western valley, which may be considered as the centre of agricultural industry.

Having been for a long time accustomed to a moderate temperature, we found the plains of the Tuy extremely hot, although the thermometer kept, in the day-time, between eleven in the morning and five in the afternoon, at only 23° or 24°. The nights were delightfully cool, the temperature falling as low as 17·5°. As the heat gradually abated, the air became more and more fragrant with the odour of flowers. We remarked above all the delicious perfume of the Lirio hermoso,* a new species of pancratium, of which the flower, eight or nine inches long, adorns the banks of the Rio Tuy. We spent two very agreeable days at the plantation of Don Jose de Manterola, who in his youth had accompanied the Spanish embassy to Russia. The farm is a fine plantation of sugar-canes; and the ground is as smooth as the bottom of a drained lake. The Rio Tuy winds through districts covered with plantains, and a little wood of Hura crepitans, Erythrina corallodendron, and fig-trees with nymphæa leaves. The bed of the river is formed of pebbles of quartz. I never met with more agreeable bathing than in the Tuy. The water, as clear as crystal, preserves even during the day a temperature of 18·6°; a considerable coolness for these climates, and for a height of three hundred toises; but the sources of the river are in the surrounding mountains. The house of the proprietor, situated on a hillock, of fifteen or twenty toises of elevation, is surrounded by the huts of the negroes. Those who are

* Pancratium undulatum.

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married provide food for themselves; and here, as everywhere else in the valleys of Aragua, a small spot of ground is allotted to them to cultivate. They labour on that ground on Saturdays and Sundays, the only days in the week on which they are free. They keep poultry, and sometimes even a pig. Their masters boast of their happiness, as in the north of Europe the great landholders love to descant upon the ease enjoyed by peasants who are attached to the glebe. On the day of our arrival we saw three fugitive negroes brought back; they were slaves newly purchased. I dreaded having to witness one of those punishments which, wherever slavery prevails, destroys all the charm of a country life. Happily these blacks were treated with humanity.

In this plantation, as in all those of the province of Venezuela, three species of sugar-cane can be distinguished even at a distance by the colour of their leaves; the old Creole sugar-cane, the Otaheite cane, and the Batavia cane. The first has a deep-green leaf, the stem not very thick, and the knots rather near together. This sugar-cane was the first introduced from India into Sicily, the Canary Islands, and West Indies. The second is of a lighter green; and its stem is higher, thicker, and more succulent. The whole plant exhibits a more luxuriant vegetation. We owe this plant to the voyages of Bougainville, Cook, and Bligh. Bougainville carried it to the Mauritius, whence it passed to Cayenne, Martinique, and, since 1792, to the rest of the West India Islands. The sugar-cane of Otaheite, called by the people of that island *Ta*, is one of the most important acquisitions for which colonial agriculture is indebted to the travels of naturalists. It yields not only one-third more juice than the creolian cane on the same space of ground; but from the thickness of its stem, and the tenacity of its ligneous fibres, it furnishes much more fuel. This last advantage is important in the West Indies, where the destruction of the forests has long obliged the planters to use canes deprived of juice, to keep up the fire under the boilers. But for the knowledge of this new plant, together with the progress of agriculture on the continent of Spanish America, and the introduction of the East India and Java sugar, the prices of colonial produce in Europe would have been much more sensibly affected by the revolutions of St.

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Domingo, and the destruction of the great sugar plantations of that island. The Otaheite sugar-cane was carried from the island of Trinidad to Caracas, under the name of *Caña solera*, and it passed from Caracas to Cucuta and San Gil in the kingdom of New Grenada. In our days its cultivation during twenty-five years has almost entirely removed the apprehension at first entertained, that being transplanted to America, the cane would by degrees degenerate, and become as slender as the creole cane. The third species, the violet sugar-cane, called *Caña de Batavia*, or *de Guinea*, is certainly indigenous in the island of Java, where it is cultivated in preference in the districts of Japara and Pasuruan.* Its foliage is purple and very broad; and this cane is preferred in the province of Caracas for rum. The *tablones*, or grounds planted with sugar-canes, are divided by hedges of a colossal gramen; the *lata*, or gynerium, with distich leaves. At the Tuy, men were employed in finishing a dyke, to form a canal of irrigation. This enterprise had cost the proprietor seven thousand piastres for the expense of labour, and four thousand piastres for the costs of lawsuits in which he had become engaged with his neighbours. While the lawyers were disputing about a canal of which only one-half was finished, Don Jose de Manterola began to doubt even of the possibility of carrying the plan into execution. I took the level of the ground with a lunette d'epreuve, on an artificial horizon, and found, that the dam had been constructed eight feet too low. What sums of money have I seen expended uselessly in the Spanish colonies, for undertakings founded on erroneous levelling!

The valley of the Tuy has its 'gold mine,' like almost every part of America inhabited by whites, and backed by primitive mountains. I was assured, that in 1780, foreign gold-gatherers had been engaged in picking up grains of that metal, and had established a place for washing the sand in the Quebrada del Oro. An overseer of a neighbouring plantation had followed these indications; and after his death, a waistcoat with gold buttons being found among his clothes, this gold, according to the logic of the people here, could only have proceeded from a vein, which the falling-in of the earth had rendered invisible. In vain I objected, that I could

* Raffles, History of Java, tom. i. p. 124.

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not, by the mere view of the soil, without digging a large trench in the direction of the vein, judge of the existence of the mine; I was compelled to yield to the desire of my hosts. For twenty years past the overseer's waistcoat had been the subject of conversation in the country. Gold extracted from the bosom of the earth is far more alluring in the eyes of the vulgar, than that which is the produce of agricultural industry, favoured by the fertility of the soil, and the mildness of the climate.

North-west of the Hacienda del Tuy, in the northern range of the chain of the coast, we find a deep ravine, called the *Quebrada Seca*, because the torrent, by which it was formed, loses its waters through the crevices of the rock, before it reaches the extremity of the ravine. The whole of this mountainous country is covered with thick vegetation. We there found the same verdure as had charmed us by its freshness in the mountains of Buenavista and Las Lagunetas, wherever the ground rises as high as the region of the clouds, and where the vapours of the sea have free access. In the plains, on the contrary, many trees are stripped of a part of their leaves during the winter; and when we descend into the valley of the Tuy, we are struck with the almost hibernal aspect of the country. The dryness of the air is such that the hygrometer of Deluc keeps day and night between 36° and 40°. At a distance from the river scarcely any huras or piper-trees extend their foliage over thickets destitute of verdure. This seems owing to the dryness of the air, which attains its maximum in the month of February; and not, as the European planters assert, "to the seasons of Spain, of which the empire extends as far as the torrid zone." It is only plants transported from one hemisphere to the other, which, in their organic functions, in the development of their leaves and flowers, still retain their affinity to a distant climate: faithful to their habits, they follow for a long time the periodical changes of their native hemisphere. In the province of Venezuela the trees stripped of their foliage begin to renew their leaves nearly a month before the rainy season. It is probable, that at this period the electrical equilibrium of the air is already disturbed, and the atmosphere, although not yet clouded, becomes gradually more

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humid. The azure of the sky is paler, and the elevated regions are loaded with light vapours, uniformly diffused. This season may be considered as the awakening of nature; it is a spring which, according to the received language of the Spanish colonies, proclaims the beginning of winter, and succeeds to the heats of summer.*

Indigo was formerly cultivated in the Quebrada Seca; but as the soil covered with vegetation cannot there concentrate so much heat as the plains and the bottom of the Tuy valley receive and radiate, the cultivation of coffee has been substituted in its stead. As we advanced in the ravine we found the moisture increase. Near the Hato, at the northern extremity of the Quebrada, a torrent rolls down over sloping beds of gneiss. An aqueduct was being formed there to convey the water to the plain. Without irrigation, agriculture makes no progress in these climates. A tree of monstrous size fixed our attention.† It lay on the slope of the mountain, above the house of the Hato. On the least dislodgment of the earth, its fall would have crushed the habitation which it shaded: it had therefore been burnt near its foot, and cut down in such a manner, that it fell between some enormous fig-trees, which prevented it from rolling into the ravine. We measured the fallen tree; and though its summit had been burnt, the length of its trunk was still one hundred and fifty-four feet.‡ It was eight feet in diameter near the roots, and four feet two inches at the upper extremity.

Our guides, less anxious than ourselves to measure the bulk of trees, continually pressed us to proceed onward and seek the 'gold mine.' This part of the ravine is little frequented, and is not uninteresting. We made the following observations on the geological constitution of the soil. At the entrance of the Quebrada Seca we remarked great masses of primitive saccharoidal limestone, tolerably fine

* That part of the year most abundant in rain is called winter; so that in Terra Firma, the season which begins by the winter solstice, is designated by the name of summer; and it is usual to hear, that it is winter on the mountains, at the time when summer prevails in the neighbouring plains.

† Hura crepitans.

‡ French measure, nearly fifty metres.

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grained, of a bluish tint, and traversed by veins of calcareous spar of dazzling whiteness. These calcareous masses must not be confounded with the very recent depositions of tufa, or carbonate of lime, which fill the plains of the Tuy; they form beds of mica-slate, passing into talc-slate.* The primitive limestone often simply covers this latter rock in concordant stratification. Very near the Hato the talcose slate becomes entirely white, and contains small layers of soft and unctuous graphic ampelite.† Some pieces, destitute of veins of quartz, are real granular plumbago, which might be of use in the arts. The aspect of the rock is very singular in those places where thin plates of black ampelite alternate with thin, sinuous, and satiny plates of a talcose slate as white as snow. It would seem as if the carbon and iron, which in other places colour the primitive rocks, are here concentrated in the subordinate strata.

Turning westward we reached at length the ravine of gold (Quebrada del Oro). On examining the slope of a hill, we could hardly recognize the vestige of a vein of quartz. The falling of the earth caused by the rains had changed the surface of the ground, and rendered it impossible to make any observation. Great trees were growing in the places where the gold-washers had worked twenty years before. It is probable that the mica-slate contains here, as near Goldcronach in Franconia, and in Salzburgh, auriferous veins; but how is it possible to judge whether they be worth the expense of being wrought, or whether the ore is only in nodules, and in the less abundance in proportion as it is rich? We made a long herborization in a thick forest, extending beyond the Hato, and abounding in cedrelas, browneas, and fig-trees with nymphæa leaves. The trunks of these last are covered with very odoriferous plants of vanilla, which in general flower only in the month of April. We were here again struck with those ligneous excrescences, which in the form of ridges, or ribs, augment to the height of twenty feet above the ground, the thickness of the trunk of the fig-trees of America. I found

* Talkschiefer of Werner, without garnets or serpentine; not *eurite* or *weisstein*. It is in the mountains of Buenavista that the gneiss manifests a tendency to pass into eurite.

† Zeichenschiefer.

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trees twenty-two feet and a half in diameter near the roots. These ligneous ridges sometimes separate from the trunk at a height of eight feet, and are transformed into cylindrical roots two feet thick. The tree looks as if it were supported by buttresses. This scaffolding however does not penetrate very deep into the earth. The lateral roots wind at the surface of the ground, and if at twenty feet distance from the trunk they are cut with a hatchet, we see gushing out the milky juice of the fig-tree, which, when deprived of the vital influence of the organs of the tree, is altered and coagulates. What a wonderful combination of cells and vessels exist in these vegetable masses, in these gigantic trees of the torrid zone, which without interruption, perhaps during the space of a thousand years, prepare nutritious fluids, raise them to the height of one hundred and eighty feet, convey them down again to the ground, and conceal, beneath a rough and hard bark, under inanimate layers of ligneous matter, all the movements of organic life!

I availed myself of the clearness of the nights, to observe at the plantation of Tuy two emersions of the first and third satellites of Jupiter. These two observations gave, according to the tables of Delambre, long. $4^h\ 39'\ 14''$; and by the chronometer I found $4^h\ 39'\ 10''$. During my stay in the valleys of the Tuy and Aragua the zodiacal light appeared almost every night with extraordinary brilliancy. I had perceived it for the first time between the tropics at Caracas, on the 18th of January, after seven in the evening. The point of the pyramid was at the height of 53°. The light totally disappeared at $9^h\ 35'$ (apparent time), nearly $3^h\ 50'$ after sunset, without any diminution in the serenity of the sky. La Caille, in his voyage to Rio Janeiro and the Cape, was struck with the beautiful appearance displayed by the zodiacal light within the tropics, not so much on account of its less inclined position, as of the greater transparency of the air.* It may appear singular, that Childrey and Dominic Cassini, navigators who were well acquainted with the seas of the two Indies, did not at a much earlier period direct the attention of scientific Europe to this light, and its regular form and progress. Until the middle of the

* The great serenity of the air caused this phenomenon to be remarked, in 1668, in the arid plains of Persia.

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eighteenth century mariners were little interested by anything not having immediate relation to the course of a ship, and the demands of navigation.

However brilliant the zodiacal light in the dry valley of Tuy, I have observed it more beautiful still at the back of the Cordilleras of Mexico, on the banks of the lake of Tezcuco, eleven hundred and sixty toises above the surface of the ocean. In the month of January, 1804, the light rose sometimes to more than 60° above the horizon. The Milky Way appeared to grow pale compared with the brilliancy of the zodiacal light; and if small, bluish, scattered clouds were accumulated toward the west, it seemed as if the moon were about to rise.

I must here relate another very singular fact. On the 18th of January, and the 15th of February, 1800, the intensity of the zodiacal light changed in a very perceptible manner, at intervals of two or three minutes. Sometimes it was very faint, at others it surpassed the brilliancy of the Milky Way in Sagittarius. The changes took place in the whole pyramid, especially toward the interior, far from the edges. During these variations of the zodiacal light, the hygrometer indicated considerable dryness. The stars of the fourth and fifth magnitude appeared constantly to the naked eye with the same degree of light. No stream of vapour was visible: nothing seemed to alter the transparency of the atmosphere. In other years I saw the zodiacal light augment in the southern hemisphere half an hour before its disappearance. Cassini admitted "that the zodiacal light was feebler in certain years, and then returned to its former brilliancy." He thought that these slow changes were connected with "the same emanations which render the appearance of spots and faculæ periodical on the solar disk." But this excellent observer does not mention those changes of intensity in the zodiacal light which I have several times remarked within the tropics, in the space of a few minutes. Mairan asserts, that in France it is common enough to see the zodiacal light, in the months of February and March, mingling with a kind of Aurora Borealis, which he calls 'undecided,' and the nebulous matter of which spreads itself all around the horizon, or appears toward the west. I very much doubt, whether, in the observations I

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have been describing, there was any mixture of these two species of light. The variations in intensity took place at considerable altitudes; the light was white, and not coloured; steady, and not undulating. Besides, the Aurora Borealis is so seldom visible within the tropics, that during five years, though almost constantly sleeping in the open air, and observing the heavens with unremitting attention, I never perceived the least traces of that phenomenon.

I am rather inclined to think that the variations of the zodiacal light are not all appearances dependent on certain modifications in the state of our atmosphere. Sometimes, during nights equally clear, I sought in vain for the zodiacal light, when, on the previous night, it had appeared with the greatest brilliancy. Must we admit that emanations which reflect white light, and seem to have some analogy with the tails of comets, are less abundant at certain periods? Researches on the zodiacal light have acquired a new degree of interest since geometricians have taught us that we are ignorant of the real causes of this phenomenon. The illustrious author of "La Mécanique Céleste" has shown that the solar atmosphere cannot reach even the planet Mercury; and that it could not in any case display the lenticular form which has been attributed to the zodiacal light. We may also entertain the same doubts respecting the nature of this light, as with regard to that of the tails of comets. Is it in fact a reflected or a direct light?

We left the plantation of Manterola on the 11th of February, at sunrise. The road runs along the smiling banks of the Tuy; the morning was cool and humid, and the air seemed embalmed by the delicious odour of the Pancratium undulatum, and other large liliaceous plants. In our way to La Victoria, we passed the pretty village of Mamon or of Consejo, celebrated in the country for a miraculous image of the Virgin. A little before we reached Mamon, we stopped at a farm belonging to the family of Monteras. A negress more than a hundred years old was seated before a small hut built of earth and reeds. Her age was known because she was a creole slave. She seemed still to enjoy very good health. "I keep her in the sun" (la tengo al sol), said her grandson; "the heat keeps her alive."

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This appeared to us not a very agreeable mode of prolonging life, for the sun was darting his rays almost perpendicularly. The brown-skinned nations, blacks well seasoned, and Indians, frequently attain a very advanced age in the torrid zone. A native of Peru named Hilario Pari died at the extraordinary age of one hundred and forty-three years, after having been ninety years married.

Don Francisco Montera and his brother, a well-informed young priest, accompanied us with the view of conducting us to their house at La Victoria. Almost all the families with whom we had lived in friendship at Caracas were assembled in the fine valleys of Aragua, and they vied with each other in their efforts to render our stay agreeable. Before we plunged into the forests of the Orinoco, we enjoyed once more all the advantages which advanced civilization affords.

The road from Mamon to La Victoria runs south and south-west. We soon lost sight of the river Tuy, which, turning eastward, forms an elbow at the foot of the high mountains of Guayraima. As we drew nearer to Victoria the ground became smoother; it seemed like the bottom of a lake, the waters of which had been drained off. We might have fancied ourselves in the valley of Hasli, in the canton of Berne. The neighbouring hills, only one hundred and forty toises in height, are composed of calcareous tufa; but their abrupt declivities project like promontories on the plain. Their form indicates the ancient shore of the lake. The eastern extremity of this valley is parched and uncultivated. No advantage has been derived from the ravines which water the neighbouring mountains; but fine cultivation is commencing in the proximity of the town. I say of the town, though in my time Victoria was considered only as a village (pueblo).

The environs of La Victoria present a very remarkable agricultural aspect. The height of the cultivated ground is from two hundred and seventy to three hundred toises above the level of the ocean, and yet we there find fields of corn mingled with plantations of sugar-cane, coffee, and plantains. Excepting the interior of the island of Cuba,* we scarcely find elsewhere in the equinoctial regions

* The district of Quatro Villas.

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European corn cultivated in large quantities in so low a region. The fine fields of wheat in Mexico are between six hundred and twelve hundred toises of absolute elevation; and it is rare to see them descend to four hundred toises. We shall soon perceive that the produce of grain augments sensibly, from high latitudes towards the equator, with the mean temperature of the climate, in comparing spots of different elevations. The success of agriculture depends on the dryness of the air; on the rains distributed through different seasons, or accumulated in one season; on winds blowing constantly from the east; or bringing the cold air of the north into very low latitudes, as in the gulf of Mexico; on mists, which for whole months diminish the intensity of the solar rays; in short, on a thousand local circumstances which have less influence on the mean temperature of the whole year than on the distribution of the same quantity of heat through the different parts of the year. It is a striking spectacle to see the grain of Europe cultivated from the equator as far as Lapland in the latitude of 69°, in regions where the mean heat is from 22° to —2°, in every place where the temperature of summer is above 9° or 10°. We know the minimum of heat requisite to ripen wheat, barley, and oats; but we are less certain in respect to the maximum which these species of grain, accommodating as they are, can support. We are even ignorant of all the circumstances which favour the culture of corn within the tropics at very small heights. La Victoria and the neighbouring village of San Mateo yield an annual produce of four thousand quintals of wheat. It is sown in the month of December, and the harvest is reaped on the seventieth or seventy-fifth day. The grain is large, white, and abounding in gluten; its pellicle is thinner and not so hard as that of the wheat of the very cold table-lands of Mexico. An acre* near Victoria generally yields from three thousand to three thousand two hundred pounds weight of wheat. The average produce is consequently here, as at Buenos Ayres, three or four times as much as that of northern countries. Nearly sixteenfold of the quantity of seed is reaped; while, according to Lavoisier,

* An *arpent des eaux et forêts*, or legal acre of France, of which 1·95 = 1 hectare. It is about 1¼ acre English.

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the surface of France yields on an average only five or six for one, or from one thousand to twelve hundred pounds per acre. Notwithstanding this fecundity of the soil, and this happy influence of the climate, the culture of the sugar-cane is more productive in the valleys of Aragua than that of corn.

La Victoria is traversed by the little river Calanchas, running, not into the Tuy, but into the Rio Aragua: it thence results that this fine country, producing at once sugar and corn, belongs to the basin of the lake of Valencia, to a system of interior rivers not communicating with the sea. The quarter of the town west of the Rio Calanchas is called *la otra banda;* it is the most commercial part; merchandize is everywhere exhibited, and ranges of shops form the streets. Two commercial roads pass through La Victoria, that of Valencia, or of Porto Cabello, and the road of Villa de Cura, or of the plains, called *camino de los Llanos*. We here find more whites in proportion than at Caracas. We visited at sunset the little hill of Calvary, where the view is extremely fine and extensive. We discover on the west the lovely valleys of Aragua, a vast space covered with gardens, cultivated fields, clumps of wild trees, farms, and hamlets. Turning south and south-east, we see, extending as far as the eye can reach, the lofty mountains of La Palma, Guayraima, Tiara, and Guiripa, which conceal the immense plains or steppes of Calabozo. This interior chain stretches westward along the lake of Valencia, towards the Villa de Cura, the Cuesta de Yusma, and the denticulated mountains of Guigne. It is very steep, and constantly covered with that light vapour which in hot climates gives a vivid blue tint to distant objects, and, far from concealing their outlines, marks them the more strongly. It is believed that among the mountains of the interior chain, that of Guayraima reaches an elevation of twelve hundred toises. I found in the night of the eleventh of February the latitude of La Victoria 10° 13′ 35″, the magnetic dip 40·8°, the intensity of the forces equal to 236 oscillations in ten minutes of time, and the variation of the needle 4·4° north-east.

We proceeded slowly on our way by the villages of San Mateo, Turmero, and Maracay, to the Hacienda de Cura, a

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fine plantation belonging to Count Tovar, where we arrived on the evening of the fourteenth of February. The valley, which gradually widens, is bordered with hills of calcareous tufa, called here *tierra blanca*. The scientific men of the country have made several attempts to calcine this earth, mistaking it for the porcelain earth proceeding from decomposed strata of feldspar. We stayed some hours with a very intelligent family, named Ustariz, at Concesion. Their house, which contains a collection of choice books, stands on an eminence, and is surrounded by plantations of coffee and sugar-cane. A grove of balsam-trees (balsamo*) gives coolness and shade to this spot. It was gratifying to observe the great number of scattered houses in the valley inhabited by freedmen. In the Spanish colonies, the laws, the institutions, and the manners, are more favourable to the liberty of the negroes than in other European settlements.

San Mateo, Turmero, and Maracay, are charming villages, where everything denotes the comfort of the inhabitants. We seemed to be transported to the most industrious districts of Catalonia. Near San Mateo we find the last fields of wheat, and the last mills with horizontal hydraulic wheels. A harvest of twenty for one was expected; and, as if that produce were but moderate, I was asked whether corn yielded more in Prussia and in Poland. By an error generally prevalent under the tropics, the produce of grain is supposed to degenerate in advancing towards the equator, and harvests are believed to be more abundant in northern climates. Since calculations have been made on the progress of agriculture in the different zones, and on the temperatures under the influence of which corn will flourish, it has been found that, beyond the latitude of 45°, the produce of wheat is nowhere so considerable as on the northern coasts of Africa, and on the table-lands of New Grenada, Peru, and Mexico. Without comparing the mean temperature of the whole year, but only the mean temperature of the season which embraces the corn cycle of vegetation, we find for three months of summer,† in the north of Europe, from 15° to 19°; in Bar-

* Amyris elata.

† The mean heat of the summers of Scotland in the environs of

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bary and in Egypt, from 27° to 29°; within the tropics, between fourteen and three hundred toises of height, from 14° to 25·5° of the centigrade thermometer.

The fine harvests of Egypt and of Algiers, as well as those of the valleys of Aragua and the interior of the island of Cuba, sufficiently prove that the augmentation of heat is not prejudicial to the harvest of wheat and other alimentary grain, unless it be attended with an excess of drought or moisture. To this circumstance no doubt we must attribute the apparent anomalies sometimes observed within the tropics, in the lower limit of corn. We are astonished to see, eastward of the Havannah, in the famous district of Quatro Villas, that this limit descends almost to the level of the ocean; whilst west of the Havannah, on the slope of the mountains of Mexico and Xalapa, at six hundred and seventy-seven toises of height, the luxuriance of vegetation is such, that wheat does not form ears. At the beginning of the Spanish conquest, the corn of Europe was cultivated with success in several regions now supposed to be too hot, or too damp, for this branch of agriculture. The Spaniards on their first removal to America were little accustomed to live on maize. They still adhered to their European habits. They did not calculate whether corn would be less profitable than coffee or cotton. They tried seeds of every kind, making experiments the more boldly because their reasonings were less founded on false theories. The province of Carthagena, crossed by the chain of the mountains Maria and Guamoco, produced wheat till the sixteenth century. In the province of Caracas, this culture is of very ancient date in the mountainous lands of Tocuyo, Quibor, and Bar-

Edinburgh, (lat. 56°), is found again on the table-lands of New Grenada, so rich in wheat, at 1400 toises of elevation, and at 4° N. latitude. On the other hand, we find the mean temperature of the valleys of Aragua, lat. 10° 13′, and of all the plains which are not very elevated in the torrid zone, in the summer temperature of Naples and Sicily, lat. 39° to 40° These figures indicate the situation of the isotheric lines (lines of the same summer heat), and not that of the isothermal lines (those of equal annual temperature). Considering the quantity of heat received on the same spot of the globe during a whole year, the mean temperatures of the valleys of Aragua, and the table-lands of New Grenada, at 300 and 1400 toises of elevation, correspond to the mean temperatures of the coasts at 23° and 45° of latitude.

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quesimeto, which connect the littoral chain with the Sierra Nevada of Merida. Wheat is still successfully cultivated there, and the environs of the town of Tocuyo alone export annually more than eight thousand quintals of excellent flour. But, though the province of Caracas, in its vast extent, includes several spots very favourable to the cultivation of European corn, I believe that in general this branch of agriculture will never acquire any great importance there. The most temperate valleys are not sufficiently wide; they are not real table-lands; and their mean elevation above the level of the sea is not so considerable but that the inhabitants cannot fail to perceive that it is more their interest to establish plantations of coffee, than to cultivate corn. Flour now comes to Caracas either from Spain or from the United States.

The village of Turmero is four leagues distant from San Mateo. The road leads through plantations of sugar, indigo, cotton, and coffee. The regularity observable in the construction of the villages, reminded us that they all owe their origin to monks and missions. The streets are straight and parallel, crossing each other at right angles; and the church is invariably erected in the great square, situated in the centre of the village. The church of Turmero is a fine edifice, but overloaded with architectural ornaments. Since the missionaries have been replaced by vicars, the whites have mingled their habitations with those of the Indians. The latter are gradually disappearing as a separate race; that is to say, they are represented in the general statement of the population by the Mestizoes and the Zamboes, whose numbers daily increase. I still found, however, four thousand tributary Indians in the valleys of Aragua. Those of Turmero and Guacara are the most numerous. They are of small stature, but less squat than the Chaymas; their eyes denote more vivacity and intelligence, owing less perhaps to a diversity in the race, than to a superior state of civilization. They work like freemen by the day. Though active and laborious during the short time they allot to labour, yet what they earn in two months is spent in one week, in the purchase of strong liquors at the small inns, of which unhappily the numbers daily increase.

We saw at Turmero the remains of the assembled militia.

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of the country, and their appearance alone sufficiently indicated that these valleys had enjoyed for ages undisturbed peace. The capitan-general, in order to give a new impulse to the military service, had ordered a grand review; and the battalion of Turmero, in a mock fight, had fired on that of La Victoria. Our host, a lieutenant of the militia, was never weary of describing to us the danger of these manœuvres, which seemed more burlesque than imposing. With what rapidity do nations, apparently the most pacific, acquire military habits! Twelve years afterwards, those valleys of Aragua, those peaceful plains of La Victoria and Turmero, the defile of Cabrera, and the fertile banks of the lake of Valencia, became the scenes of obstinate and sanguinary conflicts between the natives and the troops of the mother-country.

South of Turmero, a mass of limestone mountains advances into the plain, separating two fine sugar-plantations, Guayavita and Paja. The latter belongs to the family of Count Tovar, who have property in every part of the province. Near Guayavita, brown iron-ore has been discovered. To the north of Turmero, a granitic summit (the Chuao) rises in the Cordillera of the coast, from the top of which we discern at once the sea and the lake of Valencia. Crossing this rocky ridge, which runs towards the west farther than the eye can reach, paths somewhat difficult lead to the rich plantations of cacao on the coast, to Choroni, Turiamo, and Ocumare, noted alike for the fertility of the soil and the insalubrity of their climate. Turmero, Maracay, Cura, Guacara, every point of the valley of Aragua, has its mountain-road, which terminates at one of the small ports on the coast.

On quitting the village of Turmero, we discover, at a league distant, an object, which appears at the horizon like a round hillock, or tumulus, covered with vegetation. It is neither a hill, nor a group of trees close to each other, but one single tree, the famous *zamang del Guayre*, known throughout the province for the enormous extent of its branches, which form a hemispheric head five hundred and seventy-six feet in circumference. The zamang is a fine species of mimosa, and its tortuous branches are divided by

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bifurcation. Its delicate and tender foliage was agreeably relieved on the azure of the sky. We stopped a long time under this vegetable roof. The trunk of the zamang del Guayre,* which is found on the road from Turmero to Maracay, is only sixty feet high, and nine thick; but its real beauty consists in the form of its head. The branches extend like an immense umbrella, and bend toward the ground, from which they remain at a uniform distance of twelve or fifteen feet. The circumference of this head is so regular, that, having traced different diameters, I found them one hundred and ninety-two and one hundred and eighty-six feet. One side of the tree was entirely stripped of its foliage, owing to the drought; but on the other side there remained both leaves and flowers. Tillandsias, loranthæ, Cactus Pitahaya, and other parasite plants, cover its branches, and crack the bark. The inhabitants of these villages, but particularly the Indians, hold in veneration the zamang del Guayre, which the first conquerors found almost in the same state in which it now remains. Since it has been observed with attention, no change has appeared in its thickness or height. This zamang must be at least as old as the Orotava dragon-tree. There is something solemn and majestic in the aspect of aged trees; and the violation of these monuments of nature is severely punished in countries destitute of monuments of art. We heard with satisfaction that the present proprietor of the zamang had brought an action against a cultivator who had been guilty of cutting off a branch. The cause was tried, and the tribunal condemned the offender. We find near Turmero and the Hacienda de Cura other zamangs, having trunks larger than that of Guayre, but their hemispherical heads are not of equal extent.

The culture and population of the plains augment in the direction of Cura and Guacara, on the northern side of the lake. The valleys of Aragua contain more than 52,000 inhabitants, on a space thirteen leagues in length, and two in width. This is a relative population of two thousand souls on a square league. The village, or rather the small

* The mimos of La Guayre; *zamang* being the Indian name for the genera mimosa, desmanthus, and acacia. The place where the tree is found is called El Guayre.

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town of Maracay was heretofore the centre of the indigo plantations, when this branch of colonial industry was in its greatest prosperity. The houses are all of masonry, and every court contains cocoa-trees, which rise above the habitations. The aspect of general wealth is still more striking at Maracay, than at Turmero. The *anil*, or indigo, of these provinces has always been considered in commerce as equal and sometimes superior to that of Guatemala. The indigo plant impoverishes the soil, where it is cultivated during a long series of years, more than any other. The lands of Maracay, Tapatapa, and Turmero, are looked upon as exhausted; and indeed the produce of indigo has been constantly decreasing. But in proportion as it has diminished in the valleys of Aragua, it has increased in the province of Varinas, and in the burning plains of Cucuta, where, on the banks of the Rio Tachira, virgin land yields an abundant produce, of the richest colour.

We arrived very late at Maracay, and the persons to whom we were recommended were absent. The inhabitants perceiving our embarrassmeut, contended with each other in offering to lodge us, to place our instruments, and take care of our mules. It has been said a thousand times, but the traveller always feels desirous of repeating it again, that the Spanish colonies are the land of hospitality; they are so even in those places where industry and commerce have diffused wealth and improvement. A family of Canarians received us with the most amiable cordiality; an excellent repast was prepared, and everything was carefully avoided that might act as any restraint on us. The master of the house, Don Alexandro Gonzales, was travelling on commercial business, and his young wife had lately had the happiness of becoming a mother. She was transported with joy when she heard that on our return from the Rio Negro we should proceed by the banks of the Orinoco to Angostura, where her husband was. We were to bear to him the tidings of the birth of his first child. In those countries, as among the ancients, travellers are regarded as the safest means of communication. There are indeed posts established, but they make such great circuits that private persons seldom entrust them with letters for the llanos or savannahs of the interior. The child was brought to us at the moment

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of our departure: we had seen him asleep at night, but it was deemed indispensable that we should see him awake in the morning. We promised to describe his features exactly to his father, but the sight of our books and instruments somewhat chilled the mother's confidence. She said "that in a long journey, amidst so many cares of another kind, we might well forget the colour of her child's eyes."

On the road from Maracay to the Hacienda de Cura we enjoyed from time to time the view of the lake of Valencia. An arm of the granitic chain of the coast stretches southward into the plain. It is the promontory of Portachuelo which would almost close the valley, were it not separated by a narrow defile from the rock of La Cabrera. This place has acquired a sad celebrity in the late revolutionary wars of Caracas; each party having obstinately disputed its possession, as opening the way to Valencia, and to the Llanos. La Cabrera now forms a peninsula: not sixty years ago it was a rocky island in the lake, the waters of which gradually diminish. We spent seven very agreeable days at the Hacienda da Cura, in a small habitation surrounded by thickets.

We lived after the manner of the rich in this country; we bathed twice, slept three times, and made three meals in the twenty-four hours. The temperature of the water of the lake is rather warm, being from twenty-four to twenty-five degrees; but there is another cool and delicious bathing-place at Toma, under the shade of ceibas and large zamangs, in a torrent gushing from the granitic mountains of the Rincon del Diablo. In entering this bath, we had not to fear the sting of insects, but to guard against the little brown hairs which cover the pods of the Dolichos pruriens. When these small hairs, well characterised by the name of *picapica*, stick to the body, they excite a violent irritation on the skin; the dart is felt, but the cause is unperceived.

Near Cura we found all the people occupied in clearing the ground covered with mimosa, sterculia, and Coccoloba excoriata, for the purpose of extending the cultivation of cotton. This product, which partly supplies the place of indigo, has succeeded so well during some years, that the cotton-tree now grows wild on the borders of the lake of

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Valencia. We have found shrubs of eight or ten feet high entwined with bignonia and other ligneous creepers. The exportation of cotton from Caracas, however, is yet of small importance. It amounted at an average at La Guayra scarcely to three or four hundred thousand pounds in a year; but including all the ports of the Capitania-general, it arose, on account of the flourishing culture of Cariaco, Nueva Barcelona, and Maracaybo, to more than 22,000 quintals. The cotton of the valleys of Aragua is of fine quality, being inferior only to that of Brazil; for it is preferred to that of Carthagena, St. Domingo, and the Caribbee Islands. The cultivation of cotton extends on one side of the lake from Maracay to Valencia; and on the other from Guayca to Guigue. The large plantations yield from sixty to seventy thousand pounds a year.

During our stay at Cura we made numerous excursions to the rocky islands (which rise in the midst of the lake of Valencia,) to the warm springs of Mariara, and to the lofty granitic mountain called El Cucurucho de Coco. A dangerous and narrow path leads to the port of Turiamo and the celebrated cacao-plantations of the coast. In all these excursions we were agreeably surprised, not only at the progress of agriculture, but at the increase of a free laborious population, accustomed to toil, and too poor to rely on the assistance of slaves. White and mulatto farmers had everywhere small separate establishments. Our host, whose father had a revenue of 40,000 piastres, possessed more lands than he could clear; he distributed them in the valleys of Aragua among poor families who chose to apply themselves to the cultivation of cotton. He endeavoured to surround his ample plantations with freemen, who, working as they chose, either in their own land or in the neighbouring plantations, supplied him with day-labourers at the time of harvest. Nobly occupied on the means best adapted gradually to extinguish the slavery of the blacks in these provinces, Count Tovar flattered himself with the double hope of rendering slaves less necessary to the landholders, and furnishing the freedmen with opportunities of becoming farmers. On departing for Europe he had parcelled out and let a part of the lands of Cura, which extend towards the west at the foot of the rock of Las Viruelas.

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Four years after, at his return to America, he found on this spot, finely cultivated in cotton, a little hamlet of thirty or forty houses, which is called Punta Zamuro, and which we visited with him. The inhabitants of this hamlet are almost all mulattos, Zamboes, or free blacks. This example of letting out land has been happily followed by several other great proprietors. The rent is ten piastres for a fanega of ground, and is paid in money or in cotton. As the small farmers are often in want, they sell their cotton at a very moderate price. They dispose of it even before the harvest; and the advances, made by rich neighbours, place the debtor in a situation of dependence, which frequently obliges him to offer his services as a labourer. The price of labour is cheaper here than in France. A freeman, working as a day-labourer (peon), is paid in the valleys of Aragua and in the llanos four or five piastres per month, not including food, which is very cheap on account of the abundance of meat and vegetables. I love to dwell on these details of colonial industry, because they serve to prove to the inhabitants of Europe, a fact which to the enlightened inhabitants of the colonies has long ceased to be doubtful, viz., that the continent of Spanish America can produce sugar, cotton, and indigo by free hands, and that the unhappy slaves are capable of becoming peasants, farmers, and landholders.

END OF VOL. I.

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